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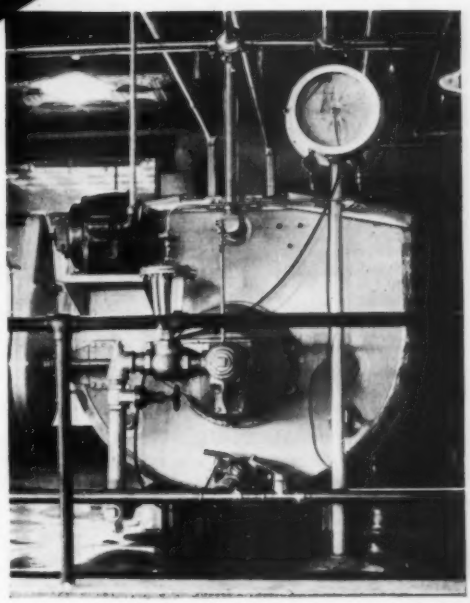

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American Dairy Science Association Announcements

NOTES ON PREPARATION OF MANUSCRIPT

There are certain problems in the presentation of scientific data that might well be considered occasionally which are continually brought to the attention of an editor by some of the manuscripts received for publication.

The primary object of preparing a manuscript based upon scientific research is to inform the reader interested in the problem of those new facts which it is desirable for him to know. The view-point of the author should not be to make a record of all that has been done during the course of the investigation. Any scientific reader does not have time to read all articles in which he is interested and he appreciates an accurate and concise presentation of methods, data, and conclusions to conserve time in learning the results. The first paragraph ought clearly set forth the problem involved so the reader will know at once whether the subject is of especial interest. Generally, the literature review gives only a brief picture of the status of information of direct concern to the problem to recall the pertinent facts and the reader formulates his opinion of the investigation from the methods, data, and conclusions. The author should draw his own conclusions from the data and not leave this to the reader. Furthermore, since many people from other lines of work may like to know the conclusions but they cannot take time to read the article, it is very desirable to make concrete, definite statements in the conclusions.

Data can often be very effectively presented as graphs for the trend may be more important than the numerical values. In preparing either graphs or tables, consideration should be given to the conservation of space in the JOURNAL as well as to the effect upon the reader. Graphs and tables crosswise of the text page are most effective. The graph can usually be adjusted by the author to the proportions of the JOURNAL page. Usually, more than four curves or the smallest rulings on a graph complicate the drawing so that the visualization of results may be hindered. About 5 to 8 columns of figures appear well in a table placed crosswise on the page. Few readers will study the detailed data given in massive tables, particularly when they extend beyond one page. Obviously, graphs and tables have little value if the reader tends only to glance at them instead of studying them.

PLACE OF 1933 ANNUAL MEETING

The executive committee has decided to hold the meeting next June in Urbana, Illinois. This decision will make it possible for members to conveniently attend the Chicago Exposition.

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A MICROSCOPIC STUDY OF ICE CREAM TEXTURE

W. C. COLE

Dairy Industry Division, University of California, Davis, California

INTRODUCTION

The organoleptic test, although very valuable in certain respects, has not proved a satisfactory measuring device when applied to observations designed to evaluate factors influencing the texture of ice cream. Generally speaking, investigators have been slow to resort to a microscopic procedure which would determine the crystal structure of ice cream and, hence, its texture. It seems, however, that the earlier attempts to develop a microscopic technique which would supplement the organoleptic test should be regarded as significant.

Physical inconveniences associated with working at extremely low temperatures, coupled with the fact that the early attempts gave results which were far from satisfactory, possibly accounts largely for the fact that a microscopic method has not been more generally used. It is felt, however, that many erroneous conclusions drawn in the past, particularly those regarding the influence of freezing upon ice cream texture, would have been avoided had a more satisfactory method been employed as a basis of evaluating the factors under consideration.

HISTORICAL

Recognizing the disadvantages of the organoleptic test a few have resorted to various means of examining ice cream samples microscopically. A brief review of the reported attempts at a microscopic examination of ice cream texture follows.

Brainerd (1) made a study of the microscopic appearance of ice cream. Using indirect lighting, he examined ice cream frozen to a pipe refrigerated by the expansion of ammonia. The pictures included in his report showed a difference in crystal structure between coarse and smooth textured samples.

Hall (2) used a modification of Brainerd's technique and examined thin flakes or sheets taken from the surface of ice cream with the aid of dissecting needles. He used a relatively low magnification in his photomicrography.

Dahlberg (3) prepared free-hand sections of ice cream and by the use of light reflected from a mirror up through the sample, studied the struc-

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ture of crystals and their arrangement in ice cream. He tried hand microtome sections, but claimed better results from the free-hand sections.

Cole (4) was unable to get satisfactory free-hand sections, but by using a rotary microtome secured samples of ice cream which were satisfactorily examined under the microscope. The photomicrographs of these samples represented a wide range in the texture of ice cream. His pictures were taken with a Leitz "Macca" micro-camera and although various magnifications were used, a magnification of 100 × was most generally employed.

Munkwitz (5) prepared samples of ice cream for microscopic study in the following manner. Paper tubes about 3 inches in diameter and fifteen inches long were filled with ice cream and after hardening the samples, the paper tubes were cut and the columns of ice cream broken. The magnification used in this work was approximately 7 ×.

METHODS

The procedure included in this report is essentially the same as that developed in 1928 and briefly reported (6). It is given in more detail with certain modifications which are considered improvements over the procedure listed in the earlier reports.

Fixing the sample: The use of a fixative on the microtome sectioning attachments prior to freezing on the samples to be examined aided considerable in preventing them from becoming detached during the time of sectioning. Egg albumin or a dextrin medium[1] served the purpose adequately.

Sectioning: In addition to free-hand sectioning, various types of microtomes were tried, but the best results were obtained with a rotary type microtome. For the work reported here a Spencer rotary microtome (Cat. No. 820) was used. With this instrument it was possible to obtain ribbon sections four to six inches in length when conditions were properly controlled.

The temperature of sectioning had to be such that the samples did not stick to the knife which was the case when the temperatures were too high. It likewise could not be too low, otherwise shattering of the sample took place. Temperatures in the neighborhood of −18° C. were most commonly used. The correct bevel of the microtome knife was likewise important in determining the type of sections obtained.

Practically all of the sectioning was done with the microtome set to cut sections varying in thickness from 10 to 15 microns. Sections which were too thick could not be properly illuminated. If they were too thin they were difficult to handle and would usually tear.

[1] The dextrin solution was prepared by adding dextrin to an aqueous solution of carbonic acid until a thick syrup was obtained.

Ice cream samples with very high overruns, also those having comparatively low freezing points, were the most difficult to section of any encountered in this study.

Microscopic observations: The microtome sections prepared as indicated above were carefully transferred to glass slides. Slight wrinkling of the samples was difficult to prevent, but it was possible to select portions of the sections which were satisfactory for microscopic examination. The use of a cover glass aided somewhat in this regard, since it tended to keep all parts of the section in the same plane. It was a decided advantage to have a flat section, although for microscopic observations slight irregularities in the sections did not materially interfere, since it was possible to vary the plane of focus during the observations. A magnification of approximately 100× was most commonly used, but observations were made in which magnifications of 40× and 430× were employed.

With the aid of an ocular scale standardized against a stage micrometer scale, it was possible to measure the dimensions of air cells as well as of crystals being studied. This was done with many of the samples, but it was later felt that the reproduction of photomicrographs was much more satisfactory providing the latter were representative of the samples under observation.

Illumination: The method of illumination consisted of reflecting light from a mirror up through the section on the stage of the microscope. A Leitz radio lamp (Cat. No. 3865) was used with a daylight screen for the early observations. This was fairly satisfactory for microscopic observations and where Kodak film packs were used it gave satisfactory results with the work in photomicrography. When commercial panchromatic plates or films were used, it was found that the use of a yellowish-green filter and a Bausch and Lomb adjustable microscope lamp (6 volts) proved more satisfactory. The proper illumination is very essential for microscopic observation, but even more important as a means of obtaining satisfactory photomicrographs.

Photographic technique: A Bausch and Lomb type R camera proved satisfactory for this work. It was a big improvement over the small camera used earlier in the investigation. It is quite likely that several other cameras could be used with equal or possibly better satisfaction. Various kinds of films and plates were used, but it seemed that commercial panchromatic films or plates gave the desired contrast. As indicated elsewhere, special filters can be used to advantage, the most satisfactory type to use being dependent upon the light sensitivity of the films or plates. If dimensions of crystals or air cells are desired, measurements can be made on the photomicrographs themselves and then by taking into consideration the magnifications used the desired dimensions can be evaluated.

CONSIDERATION OF THE PHOTOMICROGRAPHS

In the accompanying photomicrographs, there is considerable variation in the size of not only the ice crystals but the air cells as well. Possibly a word of explanation by way of distinguishing between the air cells and the crystals is not amiss at this point.

Generally speaking, the air cells are somewhat whiter in appearance than the crystals or the associated substances and consequently in most cases can easily be distinguished on the pictures from them. The air cells do not always appear round which would be the case if they were spherical in shape. Instead their sides are irregular and hence outline rather fantastic figures in some cases. This tendency is more noticeable where the air cells are large, although not entirely absent in the case of small air cells as can be seen from the accompanying reproductions. There are probably several contributing factors but a very obvious one is the projection of irregular shaped ice crystals into these cells.

The ice crystals usually appear irregular in shape. They are not as light as the air cells and they do not appear as dark as the remaining constituents in most cases. Normally it would be expected that the directions of growth of the ice crystals would vary from crystal to crystal, such that the chances of two adjacent crystals growing in exactly the same plane and direction, would be extremely remote. The irregular shaped crystals represented on the pictures can be partly accounted for on this basis, since the sectioning which was done in one plane would result in the cutting of each of the crystals at a different angle. In addition, it is known that ice crystals themselves are not uniform in shape, which would also add to the chances for the irregularities noted.

It is felt that the pictures can be considered fairly representative cross-sections of the ice cream samples included in this report.

This study was undertaken in connection with a consideration of the influence of methods of freezing upon the texture of ice cream. Hence, many other factors which might have been included have not been given consideration here. Reference to a previous article will give the details of this part of the study (7). It is felt, however, that so far as composition is concerned the ice creams studied are fairly representative of commercial products.

Plate 1, no. 1, represents an ice cream frozen by simply placing a pint of mix in the hardening room held at about –18° C. with no agitation during the freezing process. The sample was very coarse, which is indicated by the large ice crystals as well as the tendency for them to be arranged in strata. It was easily identified as an icy sample by the organoleptic test.

The samples represented by plate 1, no. 2, and plate 2, nos. 1 and 2, were all made from the same mix, but were drawn from the freezer at –2.7°

C. (27.1° F.), –3.3° C. (26.1° F.) and –4.4° C. (24.1° F.) respectively. The freezing process was completed by placing a quart of each of the samples in the hardening room along with the first sample mentioned. There was a significant difference in the crystal structure of these samples, increasing in smoothness as the temperature of drawing from the freezer was lowered.

The composition of the samples represented by plate 3, nos. 1 and 2, was essentially the same as the three previous samples. Plate 3, no. 1, was drawn from the freezer at –6.1° C. (21.0° F.) and a quart subsequently placed in the hardening room along with the other samples. The crystal structure indicated by the photomicrograph shows it to be much smoother than any of the samples so far considered. The sample represented by plate 3, no. 2, was frozen by placing a small quantity of the mix on a carbon dioxide freezing attachment. It was frozen solid in less than three minutes and as can be seen was much smoother than any of the other samples.

The contrast between the texture represented by the two photomicrographs of plate 4 indicates the changes which can occur in the texture of samples of ice cream where extreme fluctuating temperatures occur during storage. Plate 4, no. 1, shows the texture of the ice cream the day after it was drawn from the freezer while no. 2 shows the same sample 5 days later. This change occurred as a result of fluctuations in temperature during that time.

Plate 5 represents two commercial samples of ice cream which are probably better so far as texture is concerned than average commercial ice cream.

DISCUSSION

The introduction of a microscopic technique for measuring ice cream texture should be regarded as significant. Although the early attempts were accompanied by considerable handicaps, yielding results which were not very satisfactory, yet the development of the method seems to make these measurements more quantitative than was possible where the organoleptic test was the only recourse for investigators in this field.

Inadequate illumination as well as improper sectioning seem to be the most common sources of trouble where this method has been employed. Even though satisfactory photomicrographs are not always obtained and possibly are not necessary for certain types of work, it seems that the microscopic examination of prepared sections might find more general application. It is likely that its best use will be in scientific observations, although it may find some commercial applications as well.

It is recognized that by means of the tongue it is possible to determine relative differences in sizes of particles which might be taken in the mouth.

The degree of accuracy with which this can be determined is, however, a variable dependent, among other things, upon the individual making the determinations as well as upon the range in size of the particles being examined. On the other hand, the range over which the size of particles can be accurately determined microscopically is infinitely greater and hence should find greater application than the former method. In this connection it is of interest to note that the sample represented by plate 4, no. 2, was judged to be smooth organoleptically, even after the extreme fluctuations in temperature noted. It was judged to be of approximately the same smoothness as the sample represented by plate 5, no. 1. A comparison of the two photomicrographs mentioned will show them to have approximately the same texture. It can be seen further that their texture is relatively coarse compared with plate 3, nos. 1 and 2.

The coarse texture represented in plate 1, no. 1, may possibly be partly accounted for by the composition of the mix which was relatively low in fat. When that same mix was frozen rapidly its texture approached that represented by plate 3, no. 2, which compared favorably to a fine fondant in smoothness. This indicates that the major factor here was rate of freezing rather than composition.

Plate 4, no. 1, shows a smooth textured product which incidentally compares favorably with plate 3, no. 1, the two samples being frozen under almost the same conditions. It is much smoother, however, than plate 4, no. 2, which was the same sample of ice cream subsequently stored under very unfavorable conditions. The treatment was more severe than is commonly the case in commercial operation; on the other hand, the sample, to begin with, was much smoother in texture than most commercial ice creams.

Fluctuating temperatures are conducive towards the growth of large crystals at the expense of smaller ones. This may be due to the fact that for a given mass the smaller the crystals the greater their surface area and hence the greater their tendency to dissolve or go into solution. On this basis, as the temperature was increased the smaller crystals would melt first, some of them disappearing entirely. Then when the temperature was subsequently lowered, the water which had been formed as a result of the melting, would freeze around the nuclei of the crystals which were relatively large to begin with, thus causing them to increase in size with each cycle of the fluctuations in temperature.

In addition the radius of curvature of the smaller particles and hence the escaping tendency of the molecules from their surface would exceed this tendency were the radius of curvature greater. As a result of this phenomenon the tendency would also be for the large particles to grow in size at the expense of the smaller ones of the same composition. These two tendencies are in agreement with the experimental facts and it is logical to

conclude that they are contributing factors, although it is fairly certain that there are other factors concerned with these changes.

This study substantiated the conclusion already drawn (7), *viz.*, that the rate of freezing materially affects the size of the crystals formed in ice cream and further that proper methods of freezing and storage can be expected to correct many defects common to ice cream texture. It was not possible, however, to correlate the smoothness of texture as determined by the size of the ice crystals with the size or volume of air cells in the ice cream.

ACKNOWLEDGMENT

The author gladly acknowledges the assistance of Mr. Herbert Sprague, who spent considerable time working at disagreeably low temperatures assisting with the photographic work included in this report.

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(Note. This material has since appeared in Maryland Bul. 324 by R. C. Munkwitz and Devoe Meade.)

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EXPLANATION OF PLATES

PLATE 1

No. 1. Mix frozen by placing a pint of it in the hardening room maintained at about −18° C. (0° F. approx.). Composition: 6% fat, 15% sugar, 0.35% gelatin and 32.35% total solids. Freezing point −2.50° C. Magnification 100×.

No. 2. Mix drawn from a 40-quart direct expansion freezer at −2.7° C. (27.1° F.) and the freezing completed by storing sample in hardening room at about −18° C. (0° F. approx.). Composition: 12.0% fat, 15.0% sugar, 0.45% gelatin and 38.6% total solids. Freezing point −2.45° C. (27.6° F.). Magnification 100×.

PLATE 2

No. 1. Sample from same run as plate 1, no. 2, drawn from the freezer at −3.3° C. (26.1° F.) and the freezing completed as before. Magnification 100×.

No. 2. Sample from same run as plate 2, no. 1, drawn from the freezer at −4.4° C. (24.1° F.) and the freezing completed as above. Magnification 100×.

PLATE 3

No. 1. Sample drawn from a 40-quart direct expansion freezer at −6.1° C. (21.0° F.) and the freezing completed by placing it in the hardening room as previously described. Composition: 12% fat, 15% sugar, 0.35% gelatin and 37.85% total solids. Freezing point −2.69° C. (27.2° F.). Magnification 100×.

No. 2. Same mix as in plate 3, no. 1, but frozen solid in less than three minutes by placing a small amount of it on a carbon dioxide freezing attachment. It was subsequently placed in the hardening room with the other samples. Magnification 100×.

PLATE 4

No. 1. The mix from which this sample was made, although not processed at the same time, was standardized to have the same composition as the mix used in plate 3, no. 1. The sample was drawn from a 40-quart direct expansion freezer at a temperature of −6.0° C. (21.2° F.) and the freezing completed as with the other samples. Magnification 100×.

No. 2. This represents the texture of the same ice cream as in plate 4, no. 1, after the sample had been stored for 5 days, during which time wide fluctuations occurred. This was accomplished by removing the quart sample from the hardening room maintained at about −18° C. and placing it in a room at about 0° C. until the middle had reached a temperature of approximately −8° C. It was then returned to the hardening room. This fluctuation in temperature occurred 6 times in the 5-day period after hardening and before sectioning. Magnification 100×.

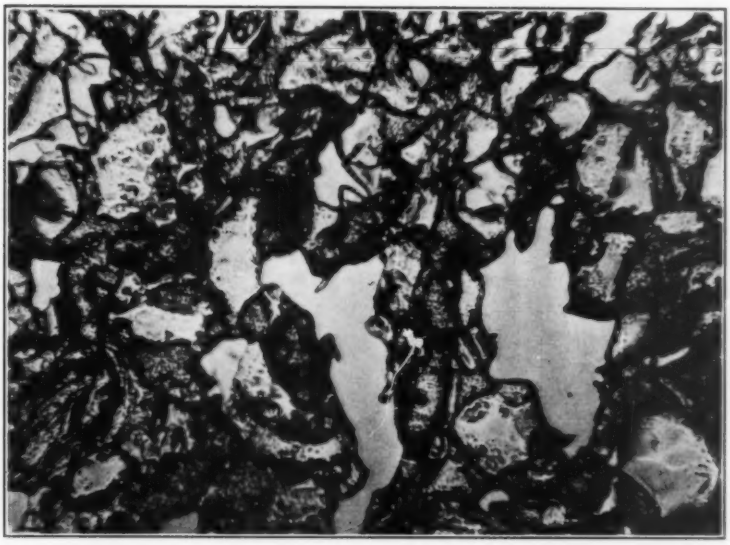
PLATE 5

No. 1. This represents the texture of a sample of commercial ice cream entered in the ice cream scoring contest at the Pacific Slope Dairy Show, November, 1931. The judges gave it a perfect score on body and texture, but at the time of photographing it was not quite as smooth as it was when scored officially. Analysis of the sample showed it to contain 13.79% fat, 40.31% total solids. Magnification 100×.

No. 2. This represents another commercial sample entered in the same contest mentioned above. It was criticized as coarse and scored 24.0 points for body and texture. This sample had likewise increased in coarseness to some extent before it was sectioned and photographed. It was, however, stored under the same conditions as the sample represented by plate 4, no. 1, after entering the contest. Analysis of the sample showed it to contain 13.72% fat, 37.09% total solids. Magnification 100×.

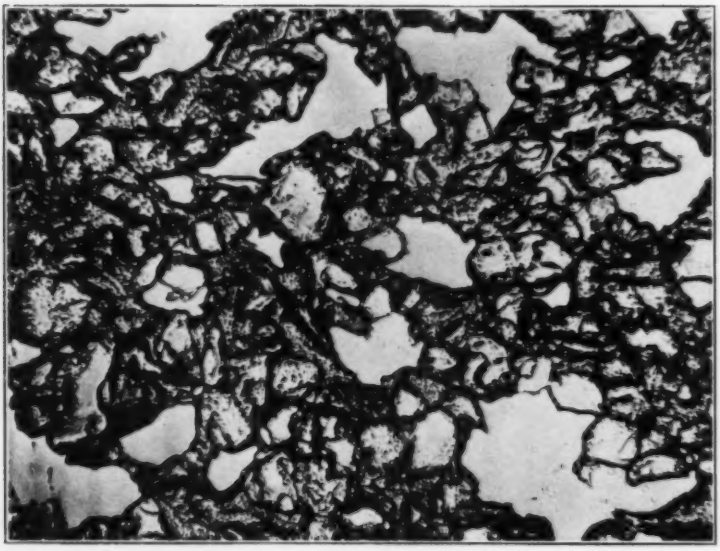
PLATE 1

No. 1



No. 2

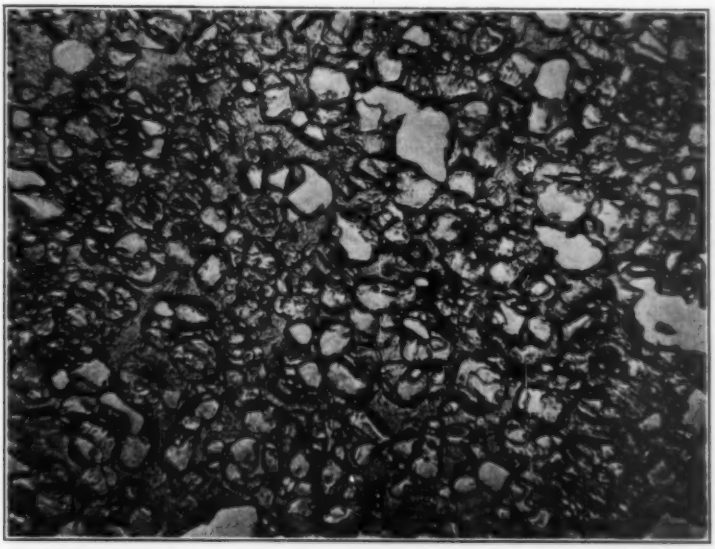
PLATE 2



No. 1

No. 2

PLATE 3



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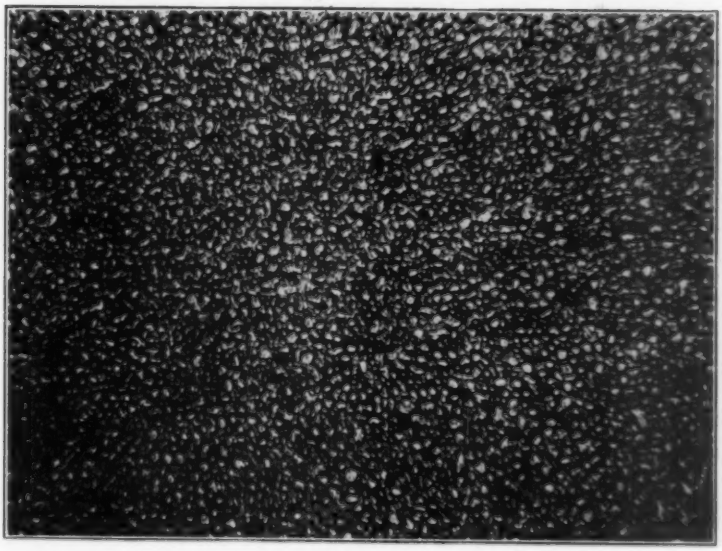

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PLATE 4

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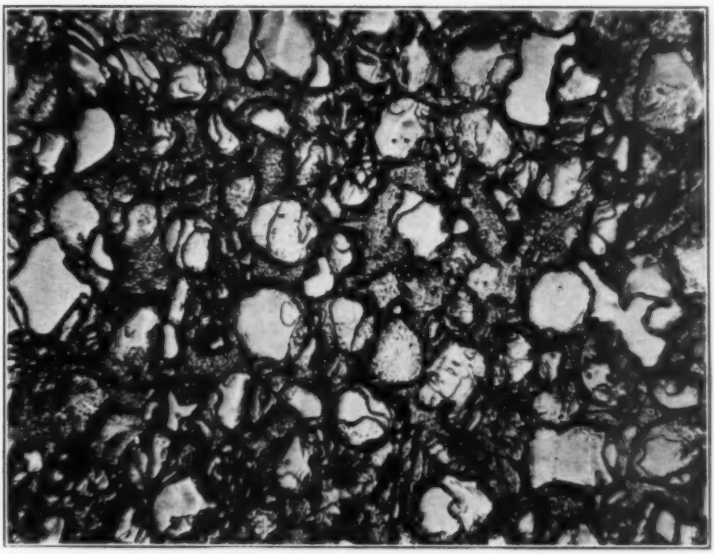
PLATE 5



No. 1

No. 2

A STUDY OF THE EFFECTS OF ALFALFA HAY AND IRRIGATED PASTURE ON GROWTH OF HOLSTEIN HEIFERS*

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The results of these investigations indicate to what extent large, growthy heifers may be developed on the common feeds produced in Wyoming. Alfalfa hay was selected as the roughage because it is found on most every irrigated farm in Wyoming where dairy cattle are kept. The number of acres in the state seeded to alfalfa is slightly below that of wild hay, but the yield is twice as great as that of wild hay, making the total tonnage of alfalfa produced much greater.

Barley was selected as the concentrate for one group of heifers, the object being to determine if a small allowance of grain would aid in producing better developed dairy cattle. The acreage of barley grown in the state increased 500 per cent from 1920 to 1928. In 1929 the acreage of barley was below the acreage of corn. Because of the greater yield of barley per acre the total production in the state was 50 per cent more than that of corn. Barley production in Wyoming has several advantages over corn. Less than one per cent of the area of the state is below 4,000 feet in altitude, and 95 per cent of the area is above 5,000 feet in altitude. Barley thrives in high altitudes where the growing season is too short and the nights too cold for corn to mature.

Two types of irrigated pastures are in use on farms in Wyoming—pastures composed of perennial grasses and pastures composed of sweet clover. Both types of pastures were grazed by heifers in this experiment.

REVIEW OF LITERATURE

It has been shown by Eckles (5, 6) that age at first calving influenced the size of cows at maturity; that a Holstein heifer should be bred to drop her first calf when 28 to 30 months old if maximum development is desired. Eckles (8) compiled growth records of a number of heifers raised at the University of Missouri. From these data Eckles drew a curve of normal growth from birth to maturity, as represented by weight and height at withers. This curve has been found useful as a basis for comparison for growth of experimental animals. In the report on normal growth, Eckles made note of the fact that "if an animal was above or below normal at a

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certain age it tends to remain about the same distance above or below normal for a long period." Using data collected from the University of Missouri dairy herd, Brody and Ragsdale (2, 3) report changes in body measurements during growth of dairy cattle and also a height-weight curve (1).

The influence of the ration on growth of dairy heifers has been shown by a number of investigations. Eckles (5, 6) showed that the difference between heavily and lightly fed heifers was more marked upon the weight than upon the skeletal growth. The ration of Eckles light fed group after six months of age consisted of alfalfa hay alone. The ration of light fed group in experiments reported by Reed (11) was similar to that of Eckles data. The light fed heifers in both experiments failed to reach "normal" size. The Nebraska Agricultural Experiment Station (4) showed a wide difference in development of heifers on light rations and heavy rations. Woll (13) fed heifers on alfalfa hay alone in winter and green alfalfa in summer. The average weight of the Holstein heifers at the start was 687 pounds at an average age of 13 months. These heifers made an average daily gain of 1.05 pounds up to freshening—a gain somewhat above normal rate. At the Huntley Montana Experiment Station (10) Holstein heifers were fed skim milk up to 9 months of age, then only alfalfa and corn silage with two months pasture during their second year. At 12 months of age these heifers averaged 721.2 pounds in weight as compared to Eckles normal weight for that age of 558 pounds. From 12 to 24 months of age the Huntley heifers gained at more than normal rate. The Huntley heifers were larger at 24 months of age than those raised at Beltsville and Ardmore Station, where a small grain allowance was given.

The most extensive work on rations for wintering dairy heifers was done by Eckles (7). In this work the wintering of 76 animals of various ages on different rations was reported. On the average the heifers wintered on alfalfa hay alone failed to make normal gains. Of the seven Holsteins in Group 2, Experiment I, only one, a 14 months old heifer, exceeded normal gains. All of the Holstein heifers were below normal size at the beginning of the experiment and varied in age from 6 to 15 months. Heifers receiving 2 pounds of corn daily in addition to alfalfa hay grew at normal rate at all ages. Eckles found that summer gains were in the reverse order to winter gains, but where gains were normal during the winter, normal pasture gains would continue. He also concluded that Holsteins were better able to thrive on roughage alone than Jerseys. The South Carolina Station (12) secured normal growth feeding heifers for three months on alfalfa hay alone. The Idaho Station (9) failed to secure normal growth when wintering heifers on alfalfa hay alone.

From the above investigations it would seem that Holstein heifers might grow at normal rate and reach a satisfactory size on roughage alone, beginning at 12 to 13 months of age, if the heifers were of more than normal size.

EXPERIMENTAL PROCEDURE

In the research reported here, twenty registered Holstein heifers, varying in age from six months to twenty-four months, were divided into two lots. During the winter the two lots of heifers were fed in separate corrals 25 x 125 feet in size. Each lot had access to a shed open on the south side, 18 x 25 feet in size.

During the winter the heifers were weighed for three consecutive days every thirty days. On the middle day of each weighing period the following measurements were taken: height at withers, width at hooks, depth of chest, circumference of heart girth, and circumference of middle. During the summer, weights were taken once every thirty days. At this time the regular measurements were also made. The heifers were bred to calf at about thirty months of age.

RATIONS FED

During the winter, Lot I received alfalfa hay exclusively, while Lot II received alfalfa hay and two pounds of ground barley per head daily. During the summer, both lots were placed on irrigated sweet clover and tame grass pasture with no grain supplement for either lot. During the winter months, the heifers were fed alfalfa hay. The hay was weighed out daily into a hay bunk. The heifers were allowed hay in slight excess of that which they would clean up. From time to time the bunks were cleaned out of all refused hay and the weigh back recorded. Second cutting alfalfa was fed, and for the most part would grade as U. S. No. 2. Block salt and water were available at all times. Ground barley was fed in a feed bunk, to which all heifers in Lot II had access.

TABLE 1

Average weights and gain in weight of heifers at 12, 16 and 27 months of age in Lots I and II

AGE IN MONTHS	AVERAGE WEIGHT IN POUNDS			POUNDS GAIN IN WEIGHT		
	GROUP 1	GROUP 2	AVERAGE	GROUP 1	GROUP 2	AVERAGE
			*Lot I**			
12	660		660			
16	764	769	766	104		104
27	1140	1128	1136	376	359	370
			*Lot II***			
12	605		605			
16	743	860	760	138		138
27	1110	1183	1128	367	323	368

*Group 1 contained 5 heifers, group 2 contained 4.

** Group 1 contained 6 heifers, group 2 contained 2.

PRESENTATION OF EXPERIMENTAL DATA

The heifers in each lot may be divided into two groups: those placed on experimental rations at 12 and 13 months of age (group 1, table 1) and those placed on experimental rations at 16 and 17 months of age (group 2, table 1). In Lot II there were three heifers which were placed on experimental feeding at the age of 6 to 8 months. One of these heifers, however, was taken off the experimental rations at 14 months of age and her monthly weights are not included for the present. The monthly weights of the other two heifers are only considered beginning at 12 months of age. Table 1 shows the average weights of the groups in both lots at 12, 16 and 27 months of age.

As may be seen in table 1, the heifers in Lot I beginning the experiment at 12 months of age were heavier at the start and at 27 months of age than the heifers in Lot II. When all heifers are taken into consideration those in Lot I were slightly heavier than those in Lot II at 27 months of age. The gains made during specified periods are also shown in Table 1.

As shown in table 1 the heifers in Lot I did not make such rapid gains from 12–16 months of age as the heifers in Lot II. In group 2 the heifers in Lot I grew at a more rapid rate than the heifers in Lot II. When all heifers are considered, the heifers in Lot I grew as rapidly as the heifers

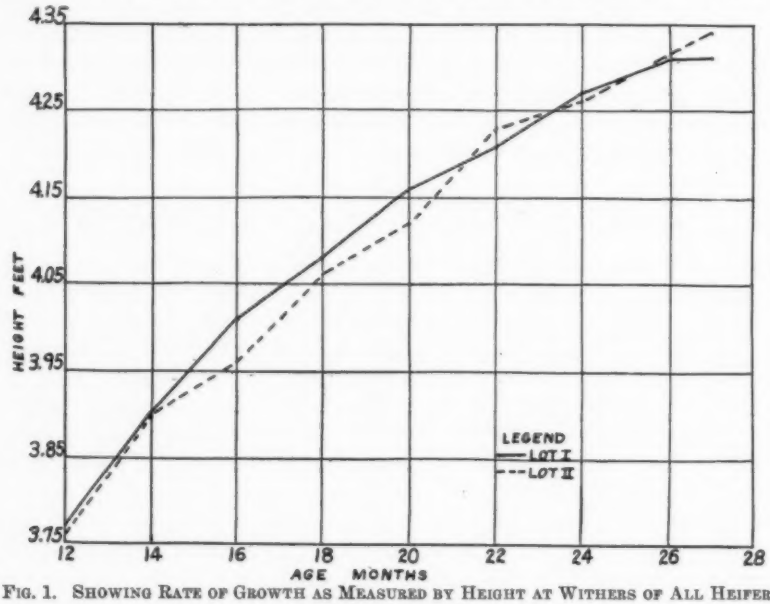

FIG. 1. SHOWING RATE OF GROWTH AS MEASURED BY HEIGHT AT WITHERS OF ALL HEIFERS IN LOTS I AND II.

in Lot II after the heifers in Lot I had reached the age of 16 months. Considering the gains of all heifers from 12 to 27 months of age, those in Lot II, or the grain fed lot, grew at a more rapid rate than the heifers in Lot I which did not receive grain.

Figure 1 shows graphically the rate of growth as measured by height at withers of all heifers. The heifers in Lot I were taller at 12 months of age than the heifers in Lot II. At 27 months of age the heifers in Lot II were slightly taller than the heifers in Lot I. The difference, however, might be said to be insignificant.

WINTER GAINS

During the winter feeding, the heifers were of varying ages. Since the hay allowance was offered to the group, the hay consumption of individual animals was not secured. The winter gains made by heifers in Lots I and II grouped by ages at start of winter feeding period is shown in table 2.

TABLE 2

Average monthly gains made during the winter by heifers in Lots I and II grouped by ages at start of winter feeding

LOT NO.	YOUNGER HEIFERS			OLDER HEIFERS		
	NUMBER HEAD	AGE AT START	AVERAGE MONTHLY GAIN	NUMBER HEAD	AGE AT START	AVERAGE MONTHLY GAIN
		months	*pounds*		*months*	*pounds*
I	4	12.25	22.40	8	19.63	31.39
II	5	9.20	31.30	6	17.33	32.35

The average length of time on winter feed extended over a period of 7.5 months. Table 2 shows that the heifers which started at 12 months of age on alfalfa alone (Lot I) did not gain as rapidly as those on alfalfa alone at an older age. It was noted in the case of two heifers which were fed for two winters that their gains made during the second winter were larger than during the first winter. Table 2 also shows that the heifers of Lot II starting at 9 months of age made larger gains than the heifers of Lot I starting at an average age of 12 months. In addition to this, note should also be taken of the fact that the heifers of Lot II starting at an older age did not make much larger gains than the heifers in the same lot starting at a younger age.

The average monthly gain of both the younger and older heifers in Lot I was 28.5 pounds as compared with 32.0 pounds for Lot II. The average monthly gain of Lot II over Lot I of 3.5 pounds is not statistically significant.

PASTURE GAINS

No grain was fed to either lot on pasture. The heifers were run on pasture continuously for a period of 3.5 months. Lot I made an average monthly gain of 35.14 pounds as compared with 44.67 pounds made by Lot II. The heifers on both lots made larger monthly gains on pastures than on their respective rations during the winter months. The average monthly gain for all heifers during the summer on pasture was 40.6 pounds as compared with 30.3 pounds while on winter feed.

COMPARISON WITH DATA FROM OTHER EXPERIMENT STATIONS

The average weights of Holstein heifers in Lot I at 12, 24, and 27 months of age are compared with the weights of heifers grown under different feeding conditions at other Experiment Stations in table 3.

TABLE 3

*Average weights of Holstein heifers in Lot I at 12, 24, and 27 months of age compared with average weights of Holstein heifers at the Huntley, Montana Station; Missouri heavily fed late calving group; Eckles normal; and Missouri lightly fed late calving group**

AGE IN MONTHS	WEIGHT IN POUNDS		
	12	24	27
Lot I, Wyoming	660.0	1043.0	1138.0
Huntley, Montana	721.2	1070.8	.....
Missouri Heavily Fed	664.0	1110.0	.....
Eckles Normal	558.0	841.0	925.0
Missouri Lightly Fed	432.0	731.0	.....

* Method of feeding cited in review of literature.

At 12 months of age the Wyoming heifers showed as great a scale as the Missouri heavy feds, but not the scale of the Huntley heifers. All three groups mentioned were above Eckles normal at twelve months and 24 months of age. The Missouri light fed heifers on the other hand were below normal at 12 and 24 months of age.

The growth as measured by height at withers of Lot I is compared in figure 2 with Holstein heifers grown under different feeding conditions at other Experiment Stations. Figure 2 shows that the Wyoming heifers were above normal at 12 months of age and grew at more than normal rate. The Kansas and Missouri lightly fed heifers show retarded development. The Wyoming heifers were below the Missouri heavily fed heifers at 12 months of age but were slightly above at the age of 24 months.

Other measurements taken besides height at withers show that the Wyoming heifers were above normal at 12 and 27 months of age. The Wyoming heifers gained for the most part at normal or above normal rate as shown in table 4.

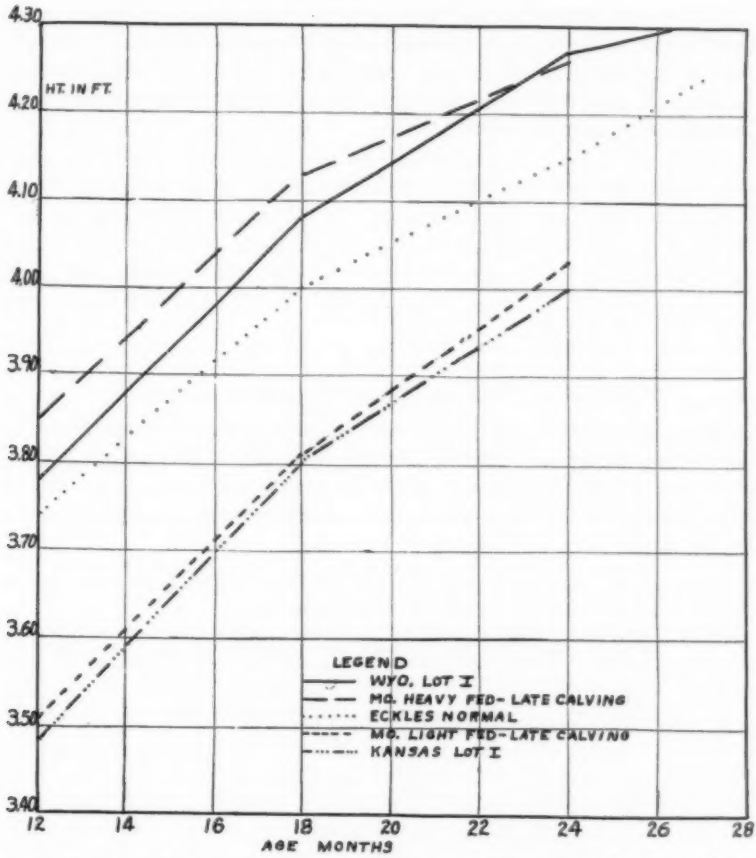

FIG. 2. SHOWING GROWTH AS MEASURED BY HEIGHT AT WITHERS OF HOLSTEIN HEIFERS FED AT MISSOURI, KANSAS AND WYOMING EXPERIMENT STATIONS.

TABLE 4

Average gain in weight and body measurements of all Wyoming heifers compared with normal between ages of 12 and 27 months

	WEIGHT	HEIGHT AT WITHERS	DEPTH CHEST	HEART GIRTH	BARREL GIRTH	WIDTH HIPS
	pounds	*feet*	*feet*	*feet*	*feet*	*feet*
Wyoming Lot I	478	.53	.37	1.10	1.27	.33
Wyoming Lot II	553	.57	.46	1.28	1.59	.44
Normal	367	.50	.37	.98	1.19	.37

The fact that the Wyoming heifers were in a good state of flesh is shown in table 5 in which the corresponding weight for height is compared with normal. A height-weight growth curve based on data secured from the Wyoming heifers would show that the Wyoming heifers were heavier at a given height than the Missouri heifers.

TABLE 5

Corresponding weight for height of the Wyoming heifers compared with normal

HEIGHT IN FEET	NORMAL WEIGHT	WEIGHT LOT I	WEIGHT LOT II
3.76	570	660	599
4.00	686	766	807
4.26	966	1043	1047

WINTER AND SUMMER GAINS COMPARED TO NORMAL

Since the heifers in this experiment were of different ages during the winter and summer, the growth of each heifer during those periods was compared with Eckles normal. Table 6 shows how the average rate of growth during the winter and pasture season compared with the normal rate.

TABLE 6

Average variation from normal weight and height of heifers in Lots I and II while on winter feed and pasture

SEASON	NO. HEAD	VARIATION FROM NORMAL WEIGHT IN POUNDS			VARIATION FROM NORMAL HEIGHT AT WITHERS IN FEET		
		AT START	AT END	GAIN OVER NORMAL RATE	AT START	AT END	GAIN OR LOSS ON NORMAL RATE
Winter							
Lot I	11	157.0	175.7	18.7	.080	.080	0
Lot II	11	107.8	154.0	46.2	.008	.087	−.079
Pasture							
Lot I	6	158.0	182.1	24.1	.093	.078	−.015
Lot II	11	120.3	172.7	52.4	.069	.060	−.009

As shown in table 6 the average gains in weight on winter and summer feed were above normal in both Lots I and II. During the winter Lot I made normal gains in height at withers while Lot II exceeded normal rate in the same measurement. Both lots failed to make normal gains in height at withers while on pasture. In weight the heifers in Lot II exceeded normal gains more than the heifers in Lot I both on winter feed and on pasture. While on pasture the gain in weight over the normal rate exceeded the gain during the winter in both lots.

There was considerable variation in the gains made by individuals in each lot. In Lot I three out of eleven head and in Lot II four out of

eleven head failed to make normal gains in weight during the winter. At the same time five out of the eleven head in Lot I and three out of the eleven head in Lot II failed to make normal gains in height at withers.

While on pasture one heifer in Lot I and two heifers in Lot II failed to make normal gains in weight. The fact that heifers receiving grain during the winter (Lot II) made the larger gains during the summer seems contradictory to usual results. Eckles (7) found, however, that heifers medium fed during the winter showed no such increase in weight during the summer as did the light fed heifers. The winter gains on alfalfa alone might be considered satisfactory.

DISCUSSION

As shown by increased rate of gain of Lot II over Lot I, the addition of two pounds of barley to the alfalfa ration during the winter months was beneficial. The heifers in Lot I were larger than the heifers in Lot II at 12 months but not at 27 months of age. From the standpoint of the practical farmer, however, the differences in the two groups are insignificant. The final weights and measurments of the two groups are very close. The work reported by Woll (13) indicates that grain feeding increased the rate of growth of heifers. However, the heifers fed alfalfa alone might be said to have made satisfactory gains.

The point of view as far as relative growth is concerned depends upon whether one is to consider normal gains as satisfactory gains. The writer believes that normal gains should be considered sufficient as long as heifers are large for their age at the time of their first calf. From this standpoint it would appear that there is no special benefit derived by feeding grain to heifers when raised under the condition of this experiment. The experiment does not show at what age exclusive hay feeding may be safely begun, but it demonstrates that large twelve months old heifers may be raised satisfactorily on alfalfa hay and irrigated pasture.

SUMMARY AND CONCLUSION

Two groups of Holstein heifers were fed on alfalfa hay as a sole roughage during the winter and grazed on irrigated pasture during the summer. One group (Lot II) received two pounds of ground barley per head daily during the winter months, while the other group (Lot I) received no grain supplement.

The data indicate that size of heifer may still be a factor influencing rapidity of growth on roughage alone even up to the age of 16 months. During the winter months the grain fed heifers made an average monthly gain of 32 pounds as compared with an average monthly gain of 28.5 pounds for the heifers fed exclusively on alfalfa hay. The older heifers made larger gains than the younger ones on alfalfa alone.

The average monthly gains on pasture for all heifers in both lots was 40.58 pounds, as compared with 30.33 pounds on winter feed. The heifers receiving ground barley during the winter made larger gains on pasture than the heifers fed alfalfa hay exclusively. Little significance can be attached to this fact, however, in view of the limited numbers involved and also because the heifers fed alfalfa hay exclusively made quite satisfactory gains during the winter months.

In comparison with growth data from other Experiment Stations, the Wyoming heifers in Lot I made a favorable showing. The Wyoming heifers made more than normal gains in body measurements as well as live weight. The Wyoming heifers were heavy for their height as compared with normal.

Even though the grain fed heifers grew at a more rapid rate, the two groups were very much the same size at 27 months. For that reason the growth of the heifers in Lot I may be considered satisfactory.

In this investigation there seems to be two reasons for the successful growth of heifers without grain:

1. The heifers were of sufficient size at twelve months of age to consume enough roughage for desirable growth.
2. The possible beneficial effect of the irrigated pasture.

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THE VITAMIN "B" AND "G" CONTENT OF DRY SKIMMED MILK AND DRY WHEY

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Since the multiple character of the water soluble vitamins has been more clearly recognized, milk has been subjected to different empirical methods of assay for the purpose of determining its relative value as a source of vitamins "B" and "G."[1] The results of these studies (1, 2, 3, 4, 5, 6, 7) are confirmatory in showing that the vitamin "B" content of milk is relatively less than its vitamin "G" content. While the methods used for obtaining these results have not been uniform, nevertheless, the data clearly show that, aside from specific manifestations of polyneuritis which may occur in the test animals under suitable conditions of experimentation, there is also a retardation of the growth rate which can be attributed specifically to inadequacy of vitamin "B."

For the purpose of estimating the relative amount of vitamin "B" and "G" in various milk products, a method previously reported from this laboratory (6) has been found to be of value. The method is based on numerous data which have shown that with a basal ration containing a meticulously purified casein, supplemented with 2 per cent rice polish, white rats obtained a sufficiency of vitamin "B" to prevent polyneuritis and at the same time maintain a constant weight for several weeks due to the small amount of vitamin "G" carried by the rice polish. The test substance when superimposed on such a ration and when fed in graduated amounts causes a growth response commensurate with the amount of vitamin "G" present. Parallel feeding of the test substance superimposed on the basal ration unsupplemented with rice polish provided a series of graduated growth rates, which in conjunction with data obtained from the ration supplemented with the rice polish can be interpreted as a measure of the relative amount of vitamin "B" in the product being tested.

EXPERIMENTAL

The above method has been used for determining the relative vitamin "B" and "G" content of certain desiccated milk products, the results from

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[1] Vitamin "B" and vitamin "G" as referred to herein will be used in conformity with the recommendations of the Committee on Nomenclature of vitamin "B" of The American Society of Biological Chemists. Science 69: 276. 1929.

which will be reported herein. Since it is generally known that high temperatures have a destructive effect upon vitamin "B," and since there is some evidence (8, 9, 10) that such an effect may result from the degree of heat used in the processing of certain milk products, dry skim milk desiccated by the Just roller process and three samples of desiccated whey were used in this study. The temperatures to which the dry skimmed milk was subjected varied between 240° F. and 258° F. during a period which did not exceed 2½ seconds (11). The dry whey designated as sample "K" was sweet rennet whey suitable for human consumption, which had been desiccated by the Krause spray process. Dry whey samples "Ko" and "P" were obtained on the commercial market and definite knowledge of the methods of desiccation and temperatures applied are not known.

White rats selected from our standardized stock colony, 22 to 26 days of age and weighing from 40 to 50 grams, were used. They were kept in individual metal cages with raised screen bottoms during the test period. The basal ration was the same as used for previous studies (6) of this character and consisted of dextrin, 63 parts; Casein, 20 parts; powdered agar agar, 2 parts; Crisco, 10 parts; salt mixture No. 40,[2] 4 parts; and cod-liver oil, 1 part. For the required parallel feeding, this ration was used with and without the 2 per cent rice polish supplement. Varying percentages of the test products were fed with each of these rations. Since dry skimmed milk contains approximately 35 per cent protein and the dry wheys from 14 to 17 per cent, the protein content of the experimental rations was adjusted by removing part of the casein of the basal ration at the higher levels at which the test substances were fed. This procedure was followed in order to avoid a disproportionate protein content at different levels.

The growth curves are shown in the accompanying charts. Each curve represents the average growth rate of 4 rats, 2 males and 2 females, with one or two exceptions. The curves show that in every instance where the test product was supplemented with rice polish an increased rate of growth occurred. This is obviously the result of the supplementing effect of the rice polish and the milk products. The lower growth rate obtained when the basal ration was unsupplemented with rice polish must be attributed to the fact that the test products do not carry a sufficient amount of both vitamins "B" and "G" to give the same growth response at comparable levels as was obtained when the limited amount of rice polish was furnished. Since it is known that rice polish has a high vitamin "B" content and relatively little vitamin "G," at least sufficient to promote growth at the level furnished in these rations, the growth results from the unsupplemented milk products interpreted in conjunction with those obtained when

[2] Steenbock, H., and Nelson, E. M., Jour. Biol. Chem. 56: 362. 1923.

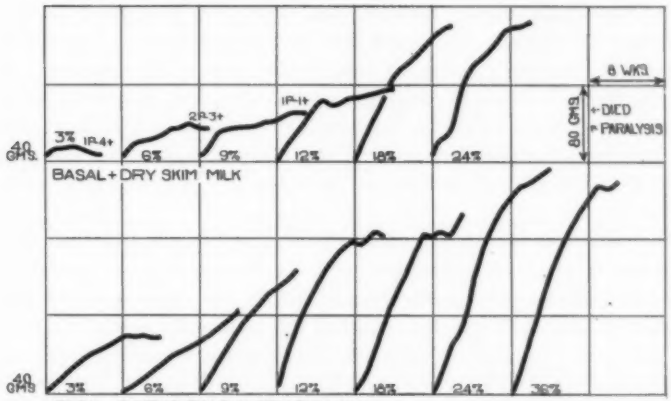

CHART 1. COMPARATIVE GROWTH RESULTS OF A VITAMIN B AND G ASSAY OF DRY SKIM MILK.

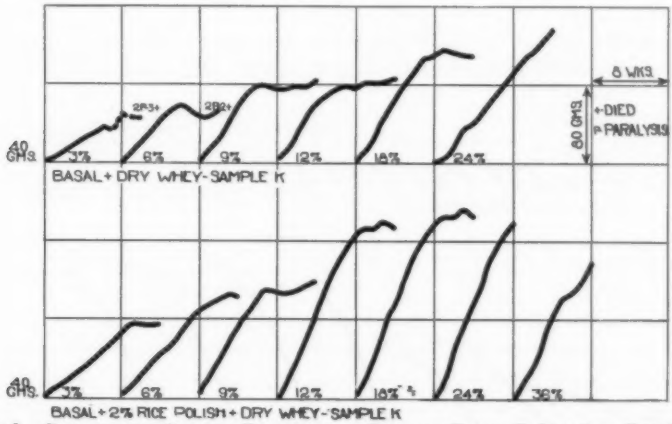

CHART 2. COMPARATIVE GROWTH RESULTS OF A VITAMIN B AND G ASSAY OF DRY WHEY, SAMPLE K.

the rice polish was furnished, must be attributed to their relatively low vitamin "B" content. A review of the results obtained from the supplemented and unsupplemented rations with which graduated levels of the test substance were fed, permits an estimation of the relative amount of vitamin "B" and "G" in any single sample, or a comparative evaluation of these factors in the different samples.

An analysis of the data indicate that there is no substantial difference in the amount of vitamin "G" in the dry skim milk and in the dry whey sample "K"; dry whey sample "P" possibly contains slightly less of this

factor. The results show, however, that there was a marked variation in the amount of vitamin "B" contained in these products. There was substantially a complete absence of this factor in dry whey sample "P" as shown by the prevalence of paralysis, comparative lack of growth, and early death of all animals receiving this product unsupplemented with rice polish. The dry skimmed milk and the dry whey sample "K" are indicated as having a slightly greater amount of vitamin "B" than dry whey sample "Ko."

Chart V shows the results obtained by superimposing the test products on the basal ration supplemented with rice polish after a period of suppressed growth caused by the elimination of all vitamin "G" with the exception of the small amount required for maintenance and as carried by the 2 per cent rice polish. The growth response resulting from the test products introduced after the period of suppressed growth corroborates the data indicating the amount of vitamin "G" in these products as determined by feeding without previous suppression of growth. (Charts 1, 2, 3 and 4.)

From the various data it is possible to estimate within limits the amount of certain of these products necessary to supply the vitamin "G" require-

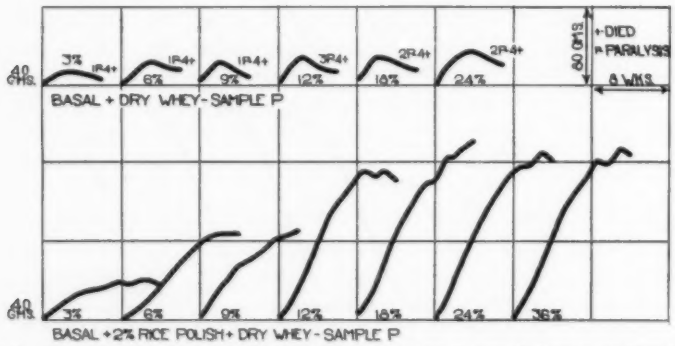

CHART 3. COMPARATIVE GROWTH RESULTS OF A VITAMIN B AND G ASSAY OF DRY WHEY, SAMPLE P.

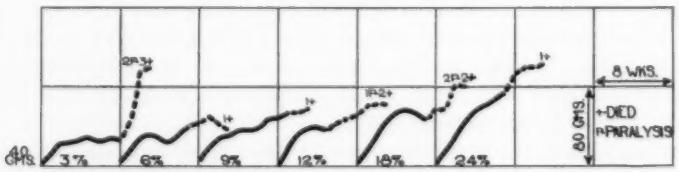

CHART 4. COMPARATIVE GROWTH RESULTS OF A VITAMIN B AND G ASSAY OF DRY WHEY, SAMPLE KO.

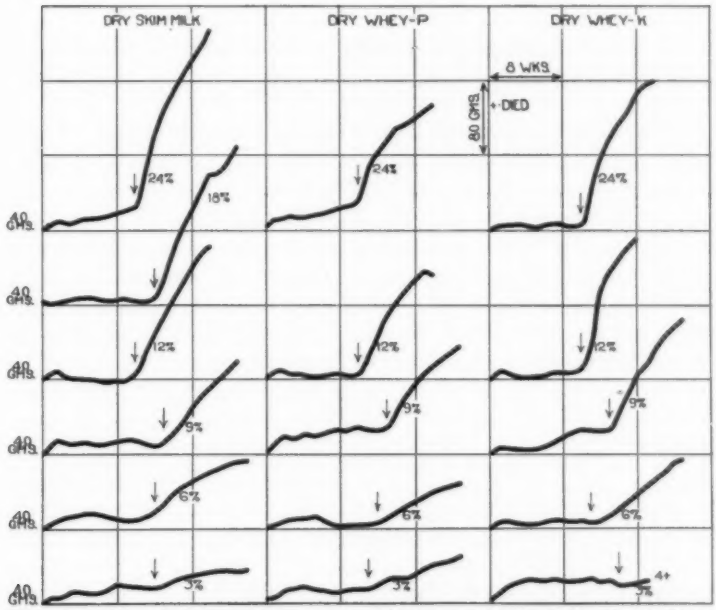

CHART 5. COMPARATIVE GROWTH RESULTS OF A VITAMIN G ASSAY OF DRY SKIM MILK AND DRY WHEYS, AFTER A PRELIMINARY PERIOD OF SUPPRESSED GROWTH. THE BASAL RATION CONTAINED 2% RICE POLISHINGS.

ment for normal or optimum growth. It appears that approximately 12 per cent dry skimmed milk or dry whey when supplemented with vitamin "B" supplies a sufficient amount of vitamin "G" for normal growth. On the basis of calculations made from the food consumption records, this is equivalent to approximately 12 to 15 cc. of fluid skimmed milk or whey per day. The data indicate, however, that none of the products, even when fed at the highest levels, furnish a sufficient amount of vitamin "B" for optimum growth. It has been noted by Supplee *et al.* (6) that either a greater amount of vitamin "B" is required at and beyond the period of adolescence than for the earlier periods of structural growth, or that some factor other than vitamin "B" and "G" as now defined is required at the later stages of the life cycle. The data recorded in this report would seem to again call attention to this point. Outhouse and coworkers (1) have indicated, however, that the flattening of the growth curve at this period may be due to the increased vitamin "B" requirement determined primarily by the increasing size of the animal.

SUMMARY

1. The growth promoting properties of the vitamin "G" content of Just roller process dry skimmed milk and spray dried whey are not substantially different.

2. There was a marked variation in the vitamin "B" content of the dry skimmed milk and dry wheys used in these experiments. It is probable that the differences in the treatment during commercial production of these various products accounts for the variations observed.

3. The vitamin "B" content of all of the desiccated products used in this study was relatively lower than the vitamin "G" content. The results indicate that the nutritive value of each of these products is greatly enhanced when supplemented with the vitamin "B" of rice polish, and unquestionably by other sources of the antineuritic factor.

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ZINC CONTENT OF MILK

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INTRODUCTION

Others have shown that the principal foods from both vegetable and animal sources usually contain small amounts of zinc. Giaya (1), Nakaseko (2), and Lehman (3) reported the constant presence of zinc in the liver of both humans and animals. Birckner (4), Hiltner and Wichman (5), and Weitzel (6) found small amounts of zinc in foods.

In so far as the authors could learn, very little information is available as to the zinc content of milk. Birckner (4) found the average amount in cows' milk to be 2.0–5.4 mgms. per kilo. He observed that the maximum amount was present in the milk immediately after parturition. His conclusions are based on 15 determinations made on 14 cows, 7 of which were 70 to 296 days after parturition, 6 the time after parturition was not known and 1 was at the end of lactation. The authors (7) determined the zinc content of cows' milk during the colostrum period.

Only a few studies have been carried out with human milk. Birckner reports 3 determinations on milk from 4 to 15 days after parturition in which a zinc content of 5.66 to 13.78 mgms. per kilo was found. There was a conspicuous increase with time, a result which was quite contrary to that obtained with cows' milk. Nakaseko (2) found 1.2 mgms. per kilo, but the time after parturition was not given.

No record was found of the zinc content of the milk of sheep.

The lack of information as to the zinc content of milk, as shown above, was supplemented by the study reported in this paper in which a slight modification of Birckner's (4) method for the estimation of small amounts of zinc in biological material was used.

MILKS ANALYZED

The human milk was obtained chiefly from 9 women from the gynecology department of the Hokkaida Imperial University. Twenty-five samples were taken 3 to 31 days after parturition, and 3 one year after parturition.

The cows' milk was obtained from 11 head (2 Ayrshire, 6 Holstein, 3 Guernsey) bred at the first and second farm of the Agricultural Department of the University. The samples were taken immediately after parturition and after 3, 4, 24, 48, 72, 96, 120, and 144 hours and from then on at convenient intervals during the lactation period.

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Sheep's milk was tested from 8 head of Ostfiethland sheep of the Tsukissao sheep farm of the Department of Agriculture and Forestry. The samples were collected daily during the early stages of lactation and from then on at monthly intervals. The pH value, specific gravity, and general composition of the milk was also determined.

METHOD OF ESTIMATING ZINC

Previously Birckner's (4) method was chiefly used in estimating the small amounts of zinc which occur in biological materials. The method was improved by using the nephelometric procedure of Breyer (8). The procedure is essentially as follows: the material is ashed, the ash dissolved in HCl solution; the zinc is precipitated as the sulphide by H_2S gas, and the zinc sulphide is collected on a filter. After washing, the zinc sulphide is dissolved in HCl solution and potassium ferrocyanide is added. The turbidity, due to the precipitated zinc ferrocyanide, is compared with standards prepared by using known amounts of zinc.

Unfortunately under the above condition some iron and manganese are precipitated as sulphides with the zinc. Consequently for an accurate determination of zinc in milk the removal of iron and manganese is necessary.

In order to overcome these errors and still use the nephelometric procedure of estimation with Birckner's method, the authors removed the iron, copper, and manganese by precipitation.

METHOD

The material is thoroughly ashed and 0.5 to 1.0 gram of the ash is dissolved in 2 N. HCl. The solution is heated to boiling and ammonium hydroxide is added to precipitate the iron, and ammonium sulphide is added to precipitate the manganese. Under these conditions (9) it is possible to precipitate manganese sulphide without precipitating zinc sulphide. After cooling, the precipitate is removed by filtration and the filtrate is made slightly acid to methyl orange with HCl. Powdered sodium carbonate is added until the solution presents a yellow color and the red color is restored by adding formic acid, drop by drop. The solution is heated to boiling, cooled and treated with H_2S gas for 24 hours.

The precipitate of zinc sulphide is collected on a small filter paper and after washing the precipitate with hydrogen sulphide saturated water, the zinc sulphide is dissolved with 6 cc. of hot 15 per cent HCl solution. After washing with boiling water, the solution is transferred to the measuring tube, and the nephelometric estimation is carried out by a comparison with standard tubes containing known amounts of zinc. The precipitation is produced by adding 5 cc. of potassium ferrocyanide and shaking.

TABLE 1

Cow's milk

Zinc content and general composition

BREED	DAYS AFTER PARTURITION	pH	SPECIFIC GRAVITY	TOTAL SOLIDS	TOTAL PROTEIN	FAT	ASH	ZINC IN 1000 CC. MILK
				%	%	%	%	*mgms.*
Ayrshire	0	6.31	1.0680	30.00	17.29	9.05	1.21	8.27
7th parturition	2	6.42	1.0370	16.02	4.49	6.97	0.86	3.82
	3	6.37	1.0375	13.94	4.67	6.46	0.78	3.09
	4	6.40	1.0370	14.15	3.54	5.17	0.78	4.33
	5	6.23	1.0380	14.84	4.33	5.76	0.76	3.22
Holstein	0	6.27	1.0375	17.36	.....	5.57	1.00	13.03
197 5th	2	6.52	1.0330	14.74	5.99	5.13	0.86	6.85
parturition	3	6.38	1.0340	15.30	4.75	5.37	0.84	...
	4	6.33	1.0330	16.60	3.50	.....	0.80	5.04
	5	6.46	1.0320	15.30	3.95	.....	0.68	5.04
	6	6.15	1.0320	14.56	3.30	.....	0.72	...
	7	6.49	1.0320	14.34	3.38	.....	0.78	4.61
Holstein	0	6.24	1.0590	19.86	11.87	3.70	0.98	4.78
239 1st	2	6.44	1.0485	16.94	6.84	5.38	0.86	5.23
parturition	3	6.33	1.0380	14.70	5.14	4.67	0.88	3.89
	4	6.34	1.0340	13.90	4.99	...	0.80	3.22
	5	6.32	1.0305	14.06	5.64	5.36	0.80	3.45
	6	6.33	1.0340	13.64	3.50	6.12	0.78	4.04
	7	6.45	1.0325	13.81	3.36	5.28	0.70	...
Holstein	0	6.36	1.0567	12.28	14.18	3.50	1.03	12.31
243 1st	2	6.41	1.0360	16.48	8.54	4.40	0.90	6.47
parturition	3	6.33	1.0320	13.82	4.83	.....	0.81	4.37
	4	6.47	1.0350	13.08	4.69	4.81	0.86	5.51
	5	6.47	1.0340	13.50	4.32	5.84	0.74	4.41
	6	6.72	1.0350	13.62	4.90	4.59	0.76	4.60
	7	6.48	1.0325	12.80	3.88	4.62	0.70	3.33
Guernsey	0	.....	1.0710	30.81	16.81	6.21	0.80	18.66
168 6th	2	.....	1.0390	14.54	4.63	5.56	0.84	6.13
parturition	3	.....	1.0350	13.47	3.43	6.06	0.81	6.11
	4	.....	1.0340	14.59	4.03	4.46	0.87	5.14
	5	.....	1.0345	.....	.....	.....	0.86	5.00
Guernsey	0	.....	1.0560	27.40	11.11	8.88	0.97	10.95
189 1st	2	.....	1.0360	16.14	4.87	5.88	0.72	4.32
parturition	3	.....	1.0280	16.06	3.75	5.63	0.76	4.30
	4	.....	1.0340	14.63	3.13	5.51	0.87	4.73
	5	.....	1.0340	15.31	4.11	5.63	0.81	3.89
	6	.....	1.0340	15.09	4.67	5.19	0.70	3.77
	7	.....	1.0350	15.33	4.41	4.71	0.73	...
Guernsey	0	6.32	1.0440	19.58	10.91	5.63	1.01	10.41
171 1st	4 hrs.	6.44	1.0430	18.73	9.73	4.05	0.86	6.12
parturition	2 days	6.43	1.0305	15.17	4.40	5.51	0.85	4.91
	45	6.52	1.0320	13.35	4.46	4.14	0.73	2.35
	65	6.31	1.0310	13.46	3.31	4.46	0.75	2.19
	90	6.70	1.0310	13.36	3.65	4.80	0.74	2.16
	150	6.41	1.0290	13.12	3.51	4.51	0.64	3.30
	180	.....	1.0287	14.24	3.81	5.62	0.66	3.18
	210	6.39	1.0280	14.92	3.44	6.43	0.73	2.41
	240	6.26	1.0285	16.30	3.48	7.76	0.66	2.32
	300	6.43	1.0315	15.81	4.18	6.55	0.75	3.33
	330	6.36	1.0337	16.14	4.30	7.11	0.77	4.45

TABLE 1 (*Continued*)

BREED	DAYS AFTER PARTURITION	pH	SPECIFIC GRAVITY	TOTAL SOLIDS	TOTAL PROTEIN	FAT	ASH	ZINC IN 1000 CC. MILK
				%	%	%	%	*mgms.*
Holstein 237 3rd parturition	0	.....	1.0440	21.61	8.54	6.92	0.93	14.19
	3 hrs.	.....	1.0430	16.67	6.85	5.05	0.93	6.61
	30 days	.....	1.0324	13.17	3.42	4.68	0.61	2.26
	60	.....	1.0310	12.48	3.51	4.15	0.63	2.46
	90	.....	1.0300	12.74	3.77	4.17	0.61	1.72
	120	.....	1.0280	12.04	3.22	4.36	0.66	2.26
	150	6.23	1.0290	13.13	4.14	4.50	0.70	2.51
	180	6.28	1.0320	13.74	3.82	4.26	0.75	2.45
	210	6.41	1.0295	13.20	3.27	4.88	0.74	2.86
	240	6.35	1.0290	12.99	3.55	4.71	0.72	3.46
	300	6.41	1.0341	12.83	3.79	3.36	0.78	3.54
	330	6.43	1.0310	13.30	3.88	4.54	0.72	3.08
	360	6.21	1.0330	13.20	3.79	4.13	0.59	3.21
	420	.....	1.0297	14.13	3.85	5.03	0.59	2.99
	480	.....	1.0323	12.09	3.74	3.04	0.54	3.69
	510	.....	1.0320	13.14	3.76	4.19	0.66	3.33
Holstein 195 3rd parturition	0	.....	1.0694	23.12	14.46	3.52	0.86	16.72
	30	.....	1.0330	13.10	4.15	5.03	0.81	3.80
Ayrshire 71 3rd parturition	Last milk of lactation	6.61	1.0331	14.77	4.25	5.56	0.78	4.65
Holstein 1st parturition	Last milk of lactation	6.68	1.0305	.....	.....	.....	0.82	5.41

STANDARD AND STOCK SOLUTION

Weigh accurately 1.2447 grams of pure zinc oxide, dissolve in HCl and add 100 cc. of distilled water; neutralize the solution with dilute ammonium hydroxide until the solution becomes transparent. Make up to a volume of one liter in a volumetric flask, using distilled water. This is the stock solution. Dilute 10 cc. of the stock solution to 100 cc. to use as a standard solution, which contains 0.1 mgm. of zinc per cc.

RESULTS

Table 1 gives the amount of zinc found in cows' milk, table 2 sheep's milk, table 3 human milk, and table 4 the average amount of zinc in human, cow and sheep milk as influenced by the period of lactation.

In addition to the data given in these tables, the following amounts of zinc were found in the milk from normal individual cows: 3.65, 3.29, 2.89,

TABLE 2

Sheep milk

Zinc content and general composition

AGE & PARTURITION	DAYS AFTER PARTURITION	pH	SPECIFIC GRAVITY	TOTAL SOLIDS	TOTAL PROTEIN	FAT	ASH	ZINC IN 1000 cc. MILK
				%	%	%	%	*mgms.*
4 years old 1st parturition	0	6.63	1.0550	.....	15.36	18.80	1.14	11.85
	2	6.56	1.0420	20.11	8.29	7.68	0.99	4.72
	3	6.65	1.0400	17.73	6.23	7.48	0.89	4.47
	4	6.59	1.0380	19.69	6.50	8.20	0.82	3.94
	7	6.66	1.0380	18.21	6.83	7.28	0.71	3.39
	1 mo.	6.59	1.0380	16.98	4.91	6.82	0.69	2.64
	2 "	6.48	1.0350	15.38	4.48	6.28	0.70	2.51
	3 "	6.50	1.0400	17.40	5.34	6.41	0.82	2.27
	4 "	6.38	1.0370	18.04	5.59	6.35	0.78	2.31
	5 "	6.43	1.0370	.....	.....	.....	0.71	2.13
	6 "	.....	1.0380	19.75	5.99	9.75	0.48	2.48
	7 "	6.54	1.0395	21.48	5.90	9.16	0.93	2.51
	8 "	6.65	1.0440	21.02	7.66	8.32	0.95	3.17
	Last milk of lactation	6.65	1.0415	22.88	6.04	9.53	0.83	2.95
4 years old 1st parturition	0	6.36	1.0620	26.34	13.12	9.88	0.92	14.72
	3	6.62	1.0380	19.42	7.64	7.85	0.92	3.43
	4	6.63	1.0310	18.87	5.68	7.83	0.90	3.38
	8	6.49	1.0380	19.95	5.32	6.72	0.89	3.06
	9	6.52	1.0360	16.28	4.68	5.87	0.82	2.52
	10	6.75	1.0350	16.78	4.80	6.44	0.82	3.11
	1 mo.	6.53	1.0350	16.15	4.52	6.29	0.76	3.16
	2 "	6.32	1.0355	16.38	4.54	7.24	0.72	2.96
	3 "	6.62	1.0370	17.72	5.29	6.33	0.75	2.81
	4 "	6.48	1.0366	17.25	5.18	6.17	0.72	2.86
	5	6.11	1.0376	.....	.....	.....	0.78	4.48
	6	.....	1.0366	16.16	7.56	7.19	0.96	2.82
	7	6.44	1.0350	22.72	6.71	10.33	0.81	3.00
	8	.....	1.0390	18.78	7.28	7.04	0.84	3.39
	Last milk of lactation	6.37	1.0408	28.86	28.86	14.21	1.08	3.36
4 years old 2nd parturition	1 mo.	6.53	1.0376	17.32	4.19	7.27	0.80	2.77
	2 "	6.39	1.0360	16.04	4.85	5.87	0.81	2.37
	3 "	6.55	1.0370	17.73	5.81	6.98	0.78	2.50
	4 "	6.33	1.0385	17.26	5.49	5.47	0.88	2.21
	5 "	.....	1.0370	17.89	.....	.....	0.84	2.67
	6 "	6.43	1.0440	17.11	6.03	9.03	0.80	2.68
	7 "	6.49	1.0422	19.32	7.08	8.24	1.06	2.91
	8 "	6.78	1.0465	25.60	9.42	10.33	1.04	3.05
5 years old 2nd parturition	1 mo.	6.55	1.0350	15.63	3.63	8.14	0.70	2.93
	2 "	6.62	1.0360	16.60	5.78	6.08	0.72	2.92
	3 "	.....	1.0370	15.92	5.26	5.27	0.77	3.72
	4 "	6.52	1.0370	14.90	4.83	4.94	0.72	1.98
	5 "	.....	1.0370	16.69	5.44	9.71	0.77	4.18
	6 "	6.57	1.0379	18.61	5.73	7.22	0.84	3.02
	7 "	6.40	1.0443	25.59	8.08	13.71	1.09	2.65
	8 "	6.80	1.0437	20.92	7.94	9.64	0.97	3.05
	Last milk of lactation	6.25	1.0300	17.24	6.63	7.68	0.85	3.39

TABLE 2 (*Continued*)

AGE & PARTURITION	DAYS AFTER PARTURITION	pH	SPECIFIC GRAVITY	TOTAL SOLIDS	TOTAL PROTEIN	FAT	ASH	ZINC IN 1000 CC. MILK
				%	%	%	%	*mgms.*
5 years old 2nd parturition	1 mo.	6.59	1.0340	13.92	3.58	6.53	0.71	3.12
	2 "	6.48	1.0350	13.35	3.70	6.70	0.74	2.79
	3 "	6.66	1.0370	15.48	5.48	5.77	0.87	3.71
	4 "	6.29	1.0350	15.94	4.77	6.01	0.68	2.34
	5 "	.....	1.0390	16.68	4.07	8.21	0.82	2.64
	6 "	6.61	1.0411	18.03	6.10	8.31	0.83	3.19
	7 "	.....	1.0434	19.63	7.26	8.28	0.81	2.67
	Last milk of lactation	.....	1.0420	20.11	7.42	7.78	0.95	3.18
4 years old 1st parturition	1 mo.	6.30	1.0360	17.77	5.63	5.58	0.76	3.48
	2 "	6.05	1.0365	16.96	4.91	5.88	0.73	3.22
	3 "	6.38	1.0360	17.68	5.31	6.40	0.75	3.26
	4 "	6.43	1.0360	17.32	5.22	6.38	0.76	2.90
	5 "	.....	1.0370	17.89	.....	.....	0.84	3.58
	6 "	6.42	1.0380	17.32	5.49	.....	0.81	3.40
	7 "	6.46	1.0376	22.50	6.74	10.41	1.03	4.08
	Last milk of lactation	6.65	1.0415	22.80	8.68	9.58	0.83	3.64
4 years old 1st parturition	1 mo.	6.48	1.0370	16.65	5.15	5.70	0.82	2.84
	2 "	6.31	1.0370	15.90	4.66	5.67	0.72	1.92
	3 "	6.38	1.0360	17.39	4.95	7.16	0.86	2.91
	4 "	6.38	1.0360	17.96	5.23	6.35	0.68	2.60
	5 "	6.61	1.0370	18.04	5.59	6.35	0.78	2.62
	6 "	6.40	1.0402	15.82	5.49	5.57	0.85	2.27
	7 "	6.40	1.0401	19.64	6.46	7.90	0.87	3.06
	8 "	6.66	1.0699	20.04	6.64	7.40	0.86	2.37
	Last milk of lactation	6.10	1.0355	18.91	9.96	7.85	0.98	3.68
4 years old 1st parturition	0	6.29	1.0609	30.22	16.94	10.16	0.92	14.42
	1 mo.	6.47	1.0360	16.33	5.02	5.98	0.65	2.41
	2 "	6.36	1.0355	15.76	4.34	5.91	0.75	3.10
	3 "	6.66	1.0375	17.26	4.81	6.74	0.82	2.81
	4 "	.....	1.0360	17.28	5.51	6.54	0.72	1.94
	5 "	6.40	1.0491	19.84	6.46	7.90	0.87	2.19
	6 "	.....	1.0390	19.81	6.68	10.78	0.99	2.46
	7 "	6.51	1.0340	19.86	6.42	9.40	0.87	2.37
	8 "	6.62	1.0344	19.13	6.75	8.09	0.96	2.84

2.00, and 3.33 mgms. per 1,000 cc. Samples of normal mixed herd milk gave 3.46, 2.94, 3.27, 4.12, 3.12, 3.15, and 3.33 mgms. per 1,000 cc. of milk.

Contrary to Birckner's three determinations of 5.66 mgms. at 4 days, 11.5 mgms. at 9 days and 13.78 mgms. at 15 days, the results presented here show that the zinc content of human milk decreases fairly definitely during the first few days after parturition. The greatest decrease in zinc takes place during the first few days of lactation; after about 10 to 15 days the zinc content becomes nearly constant and continues at about the same

TABLE 3
Zinc content of human milk

EXPERIMENT NO.	TIME AFTER PARTURITION	ZINC IN 1000 CC. OF MILK
	days	*mgms.*
	3	7.35
I	5	7.40
	7	6.46
II	4	4.43
	11	5.33
	4	5.80
	6	4.54
	8	6.16
	10	3.70
	15	3.09
III	16	2.86
	24	2.78
	25	1.23
	30	1.76
	32	1.60
IV	9	5.17
	10	3.72
V	6	6.35
	7	6.20
	10	4.89
VI	14	4.44
	15	4.03
VII	28	3.03
	30	3.63
VIII	360	3.07
	381	2.89
IX	360	3.84

level throughout the remainder of the lactation period, with perhaps a possible increase at the end of lactation.

The zinc content of the milk of cows and sheep is about the same as that of human milk. Also the zinc content was quite high immediately after parturition, falling to a relatively constant value in about 10 days. An increase in the zinc content at the end of lactation was noted, particularly in the case of cows' milk, as shown particularly by the last two values in table 1.

TABLE 4
Influence of stage of lactation upon zinc content of milk

HUMAN		COW		SHEEP	
TIME AFTER PARTURITION	ZINC IN 1000 CC. OF MILK	TIME AFTER PARTURITION	ZINC IN 1000 CC. OF MILK	TIME AFTER PARTURITION	ZINC IN 1000 CC. OF MILK
days	*mgms.*	*hours*	*mgms.*	*days*	*mgms.*
3	7.35	0	13.57	0	13.78
4	5.12	3	6.61	2	4.71
5	6.34	4	6.12	3	3.90
6	5.03	days	.....	4	3.36
7	6.18	2	5.31	7	3.18
8	6.71	3	4.35	8	3.06
9	5.19	4	4.68	9	3.04
10	4.42	5	4.16	10	3.11
11	5.33	6	4.18	months	.....
14	4.44	7	4.19	1	2.89
15	3.56	months	.....	2	2.81
16	2.86	1	2.29	3	2.83
24	2.78	2	2.35	4	2.45
25	1.23	3	2.12	5	2.69
28	3.03	4	2.28	6	2.74
30	2.67	5	3.07	7	2.91
32	1.60	6	3.00	8	2.97
1 year	3.25	7	2.63	last	3.21
		8	2.89		
		10	3.44		
		11	3.76		
		12	3.21		
		14	2.99		
		16	3.69		
		17	3.33		

SUMMARY

1. A modification of Birckner's method for the determination of zinc was developed whereby the interfering iron and manganese were removed.

2. The zinc content of human, cow, and sheep's milk was determined at various intervals throughout the lactation period.

3. Little difference was noted in the zinc content of human, cow, and sheep's milk.

4. A marked decrease in the zinc content of milk was noted during the first few days of the lactation period. During the middle normal portion of the lactation period the zinc content of the milk was about constant, but increased in amount at the end.

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MANGANESE CONTENT OF MILK

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INTRODUCTION

The existence of manganese in blood and animal tissue has been known for a long time. Warzer (1) in 1830 reported its existence in blood. Bertrand (2) in 1905 found that minute amounts of manganese affected the growth of bacteria exerting a catalytic function. Bradley (3) in 1907 found manganese in the tissue and eggs of shell fish in fresh water. Dumetrescou and Nicolau (4) in 1910 determined the manganese content of fishes and hen's egg. Bertrand and Medigreceanu (5) in 1912 observed the existence of manganese in normal blood. They (6) also investigated the manganese content of the tissues of invertebrates, fishes, and lower animals, as a result of which they concluded that manganese played a very important rôle in growth and functions of animals. Reiman and Minot (7) in 1920 who made quite a study of the manganese content of human blood and tissues, pointed out that with but few exceptions, there was a constant level of manganese in the blood. Its presence in tissues is confined largely to the liver as in other animals.

Manganese in milk has received but little attention. Dumetrescou and Nicolau (4) determined manganese in milk and Bertrand and Medigrecianu (6) showed that milk contained a small amount of manganese. Nakaye (8) after studying the manganese content of plants and animals, turned his attention toward milk. He determined the manganese content of normal and colostrum milk, being interested in whether the manganese content of the milk was affected by the growth of the calf. Unfortunately his method was not adequate for milk.

The present paper deals with the authors' study of manganese in milk. It was found that the previously used analytical methods for the determination of manganese in biological material were unsuited to milk. Not only because of an error in the methods but because too much material was required. (Nayake found that 1000 cc. was not sufficient.) The first step therefore was the development of a method which was suitable for milk.

METHOD FOR MANGANESE

The methods (4), (5), (7), (9), (10), (11) hitherto developed for the determination of manganese in biological material are quite varied. The ordinary colorimetric method is most often used.

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In applying this method to milk the color is interfered with by the formation of a precipitate with the chloride and phosphate radical contained in the milk. This interference was avoided by heating with concentrated nitric acid. By a quantitative relation between the amount of potassium persulphate and silver nitrate added an accurate determination of manganese could be made using small amounts of materials to be tested.

Method. The sample was ashed at dull redness until the carbon was completely removed. The ash (1.0–2.0 grams) was then treated with 15 cc. of a 50 per cent solution of nitric acid and left for 24 hours. It was then heated gently on a sand bath until it was thoroughly dry. After cooling the residue was well moistened by adding 5 cc. of 2 N. nitric acid and 5 cc. of distilled water. The solution was warmed on a sand bath for half an hour and when digestion was complete it was filtered with thorough washing into a volumetric flask. To the filtrate 0.2 cc. of a 2 per cent solution of silver nitrate and 0.2 grams of potassium persulphate were added. The solution was then heated gently on a sand bath until the maximum color had developed. The depth of color was then compared with that of a standard solution of potassium permanganate, using a Leitz colorimeter.

Standard stock solution. 2.877 grams of pure potassium permanganate were dissolved in water and a little sulphurous acid was added to discharge the color of the potassium permanganate. The solution was made up to a volume of 1000 cc. Each cc. of this solution contains 1.0 mgm. of manganese.

TABLE 1

Recovery of manganese added to milk

0.01 or 0.02 mgm. of manganese used for color standard

	VOLUME OF MILK SAMPLE TAKEN FOR ASHING	WEIGHT OF ASH TAKEN FOR ANALYSIS	AMOUNT OF MANGANESE ADDED TO MILK	TOTAL MANGANESE FOUND	MANGANESE RECOVERED
	cc.	*grams*	*mgms.*	*mgms.*	*mgms.*
Mixed milk		1.0	0	0.0066	
(colostrum)		1.0	0.01	0.0167	0.010
"	185	1.5	0	0.0115	
	185	1.5	0.01	0.0215	0.0100
"	162	1.2	0	0.0088	
	162	1.2	0.01	0.0181	0.0093
Mixed milk	194	1.5	0	0.0056	
(normal)	194	1.5	0.01	0.0151	0.095
"	194	1.5	0	0.0056	
	194	1.5	0.02	0.0266	0.0210
Individual	200	.....	0	0.0060	
(normal)	200	.....	0.01	0.0147	0.087

TABLE 2

Cows' milk (Colostrum)

Manganese content and general composition

BREED	TIME AFTER PARTURITION	pH	SPECIFIC GRAVITY	COLOR			TOTAL SOLIDS	TOTAL PROTEIN	ASH	FAT	MANGANESE IN 1000 CC.
				Red	Yellow	Blue					
	hours						%	%	%	%	*mgms.*
Ayrshire 86 5th parturition	0	6.38	1.0510	0.4	0.4	.....	22.48	10.14	8.70	1.06	0.161
	24	6.28	1.0365	0.3	0.4	0.4	18.02	5.65	5.33	0.90	0.069
	48	6.41	1.0320	0.4	0.2	0.6	15.88	4.98	4.37	0.86	0.060
	72	6.44	1.0320	0.2	0.2	0.3	14.58	3.94	4.77	0.74	0.056
	96	6.45	1.0345	0.3	0.3	0.3	13.52	3.71	4.44	0.86	0.065
Ayrshire 115 1st parturition	0	6.45	1.0460	0.4	0.4	0.1	22.78	9.96	8.56	1.04	0.210
	24	6.52	1.0395	0.4	0.2	0.4	16.04	5.19	5.19	0.90	0.057
	72	6.51	1.0360	0.2	0.2	0.3	11.70	3.83	4.30	0.76	0.045
	96	6.57	1.0330	0.3	0.4	0.7	13.73	3.92	4.26	0.88	0.060
Holstein 173 8th parturition	0	6.27	1.0567	0.5	0.6	0.1	22.20	10.65	7.81	0.91	0.154
	24	6.39	1.0320	0.5	0.4	0.3	16.70	4.77	6.55	0.74	0.083
	48	6.44	1.0340	0.2	0.4	0.2	13.42	4.16	4.75	0.70	0.046
	72	6.22	1.0320	0.6	0.4	0.4	12.82	4.25	4.00	0.72	0.056
	96	.....	1.0330	0.3	0.4	0.3	13.36	3.51	4.90	0.78	0.053
Holstein 249 1st parturition	0	6.31	1.0650	0.8	0.6	0.2	26.38	16.24	6.69	1.02	0.205
	24	6.48	1.0345	0.8	0.4	0.6	14.46	5.01	4.30	0.82	0.060
	48	6.44	1.0345	0.7	0.3	0.6	13.76	4.61	3.91	0.78	0.062
	72	6.31	1.0320	0.3	0.3	0.2	13.36	3.96	4.99	0.62	0.047
Guernsey 171 1st parturition	0	6.41	1.0650	0.8	0.5	0.3	20.46	13.73	5.92	0.98	0.104
	24	6.38	1.0400	0.6	0.4	0.3	16.02	5.89	5.72	0.97	0.057
	48	6.62	1.0355	0.6	0.3	0.2	14.30	4.13	5.37	0.81	0.068
	96	6.40	1.0330	0.3	0.4	0.4	13.55	4.52	5.11	0.76	0.076

Standard working solution. 5 cc. of the above stock solution were diluted to 500 cc. with distilled water. Each cc. of this solution contains 0.01 mgms. of manganese.

Results obtained when this method was applied to milk to which known amounts of manganese were added are given in table 1. This table shows that the method is quite reliable when it comes to determining the amount of added manganese.

SOURCES OF MILK SAMPLES

Cows' Milk. The milk from 2 Holstein, 2 Ayrshire and 1 Guernsey cows which were bred at the first and second farms of the Hokkaido Imperial University was tested for manganese. The milk was examined immediately after parturition and on the 2nd, 3rd, 4th, and 5th days after parturition. The manganese content of normal milk was determined by examining mixed milk and milk from individual cows.

Sheep milk. Samples were obtained from 4 sheep which were bred at the Tsukisappu sheep farm of the Department of Agriculture and Forestry. The samples were obtained at 30 day intervals.

Horse milk. Samples of normal horse milk were obtained from the veterinary hospital of the Hokkaido Imperial University.

RESULTS

Table 2 shows the manganese content of cows' milk during the first few days after parturition, and table 3 of normal milk. Tables 4 and 5 show the manganese content of sheep and horse milk, respectively. Table 6 gives the maximum, minimum and average manganese content of the milk from the different animals under the various conditions.

TABLE 3

Cows' milk (Normal)

Manganese content and general composition

NO. OF EXPERIMENT	BREED	SPECIFIC GRAVITY	TOTAL SOLIDS	TOTAL PROTEIN	FAT	ASH	MANGANESE IN 1000 CC.
I	Holstein						
	Individual	1.0297	13.30	3.88	4.54	0.72	0.036
	"	1.0340	12.83	3.79	3.76	0.78	0.039
I	Mixed	1.0280	13.00	3.85	3.65	0.71	0.031
II	"	1.0310	12.41	3.41	3.50	0.73	0.026
III	"	1.0300	12.69	4.02	3.79	0.66	0.048
IV	"	1.0285	13.11	.....	.....	0.71	0.019
V	"	1.0290	13.07	4.05	3.66	0.70	0.031
VI	"	1.0287	12.60	4.00	3.77	0.66	0.033

TABLE 4
Sheep milk
Manganese content and general composition

AGE AND PARTURITION	TIME AFTER PARTURITION	pH	SPECIFIC GRAVITY	COLOR			TOTAL SOLID	TOTAL PROTEIN	FAT	ASH	MANGANESE IN 1000 CC.
				Red	Yellow	Blue					
	days						%	%	%	%	*mgms.*
5 yrs. old 2nd parturition	60	6.60	1.0360	0.2	0.1	1.1	16.60	5.78	6.08	0.72	0.050
	90	.....	1.0370	0.7	.....	2.1	15.92	5.26	5.27	0.77	0.051
	150	6.62	1.0370	1.1	0.1	0.7	16.69	5.44	9.71	0.77	0.064
	210	6.57	1.0379	1.0	1.2	2.0	18.61	5.73	7.22	0.84	0.092
	240	6.80	1.0437	0.4	0.5	1.3	20.92	7.94	9.64	0.97	0.084
4 yrs. old 1st parturition	60	6.36	1.0355	0.4	0.1	0.9	15.76	4.34	5.91	0.75	0.046
	90	6.66	1.0375	0.5	.....	0.2	17.26	4.81	6.74	0.85	0.041
	150	.....	1.0360	0.7	.....	2.0	17.48	5.51	6.54	0.72	0.045
	210	.....	1.0390	0.5	0.9	1.0	19.81	6.68	10.78	0.91	0.064
	240	6.62	1.0344	0.3	0.2	1.0	19.13	6.75	8.09	0.96	0.067
4 yrs. old 1st parturition	60	6.35	1.0365	0.1	0.1	0.7	16.96	4.91	5.88	0.73	0.052
	90	6.38	1.0360	0.3	.....	1.2	17.68	5.37	4.40	0.75	0.057
	150	6.43	1.0370	0.1	.....	0.7	17.89		6.36	0.76	0.071
	210	.....	1.0380	0.1	.....	0.5	17.32	5.49	.....	0.81	0.115
4 yrs. old 1st parturition	60	6.31	1.0370	0.2	0.1	0.8	15.90	4.66	5.67	0.72	0.054
	90	6.38	1.0360	0.3	.....	1.2	17.34	4.95	7.16	0.86	0.062
	210	6.01	1.0420	0.1	0.1	0.4	15.85	5.49	5.57	0.85	0.060
	240	6.66	1.0399	0.2	0.1	0.3	20.01	6.64	7.40	0.86	0.077

TABLE 5

Horse milk

Manganese content and general composition

NO. OF EXPERIMENTS	TIME AFTER PARTURITION	SPECIFIC GRAVITY	TOTAL SOLIDS	TOTAL PROTEIN	FAT	ASH	MANGANESE IN 1000 CC.
	days		%	%	%	%	*mgms.*
I	160	1.0105	8.52	2.12	1.60	0.36	0.041
II	162	1.0210	7.81	2.36	1.82	0.39	0.042
III		1.0270	11.41	2.02	2.79	0.46	0.037
IV		1.0251	9.51	3.41	2.50	0.40	0.039

TABLE 6

Minimum, maximum and average manganese content of milk

MAMMAL	DESCRIPTION	TIME AFTER PARTURITION	MANGANESE IN 1000 CC.		
			Minimum	Maximum	Average
		days	*mgms.*	*mgms.*	*mgms.*
Cows' milk	Colostrum	0	0.10	0.21	0.16
		1	0.05	0.08	0.07
		2	0.05	0.06	0.06
		3	0.04	0.05	0.05
		4	0.05	0.06	0.06
	Normal				
	(Individual)		0.03	0.04	0.03
	(Mixed)		0.02	0.04	0.03
Sheep milk		60	0.04	0.05	0.05
		90	0.04	0.06	0.05
		150	0.04	0.07	0.06
		210	0.06	0.11	0.09
		240	0.06	0.08	0.07
Horse milk	Normal		0.03	0.04	0.04

Tables 2 and 6 show quite clearly that the first colostrum milk after parturition contains proportionally a much larger amount of manganese than does the normal milk. The amount of manganese being much less the second day. During the first 4 days after parturition the milk contains about twice as much manganese as does normal milk.

Sheep milk as shown by table 4 contains considerably more manganese than cows' milk and the manganese shows a tendency to increase toward the end of the lactation period.

Tables 5 and 6 indicate that normal horse milk may be slightly higher in manganese than normal cows' milk.

SUMMARY

1. A modification of the colorimetric method for the determination of manganese in biological material was developed whereby the interference of the precipitation of chlorides and phosphates were avoided.

2. Colostrum milk (cows') contains much more manganese than does normal milk, the first sample after parturition being especially high in manganese.

3. Sheep milk is higher in manganese than is cows' or horse milk.

4. The manganese content of sheep milk tends to increase toward the end of lactation.

Normal horse milk contains slightly more manganese than does normal cows' milk.

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A BIOCHEMICAL STUDY OF IRRADIATED MILK

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Recently O'Brien, Davis and Armstrong[1] have described a method for irradiating milk with ultraviolet light. Their source of light is an arc from carbon electrodes of special composition and has an energy emission, in the wave length region from 2,800 to 3,100 Ångstrom units, 1,260 times that of bright sunlight. There is very little energy emitted at wave lengths shorter than 2,800 Å. They point out that radiation of wave lengths between 2,800 to 3,100 Å. is very effective in producing anti-rachitic potency, while radiation of wave lengths less than 2,800 Å. is destructive to vitamin A, causes protein coagulation and produces a bad odor and taste in the milk. The apparatus in which the milk is irradiated is essentially a glass cylinder. The carbon arc is in the center of this cylinder and the milk flows down the inside of the cylinder in a thin film in such a way that each particle of milk receives a uniform dosage of light. Feeding experiments which they have conducted show that the vitamin D potency of irratiated milk is increased 16 times, while the vitamin A potency is 86 per cent. of that in the original milk. They also report bacteriological studies showing a decided reduction in the bacterial count after irradiation.

In the present paper a biochemical study of milk and butter from milk irradiated by the above process is reported. Since it was anticipated that effects of irradiation would be slight, the milk used in the following work was given a much longer exposure to ultraviolet light than is the usual practice. This was accomplished by passing it thru the irradiating process eight times. In this way it was hoped that any effects of ultraviolet light would be greatly exaggerated and therefore more easily detected by the methods employed. The samples of certified milk were irradiated at a plant located near Erie, Pennsylvania. Uniform samples of irradiated and non-irradiated milk were cooled, placed in thermos bottles and shipped to our laboratory at State College, arriving the following morning in good condition.

EXPERIMENTAL

Chemical Composition of Milk

The object of this phase of the work was to determine what changes in chemical composition, if any, take place during irradiation. Several sets

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[1] O'Brien, B., Davis, A. G., and Armstrong, E. L. Combined bactericidal and antirachitic effects induced in milk by carbon arc irradiation. Penna. Med. Jour. April, 1931.

of samples were analyzed before and after irradiation. A typical set of analyses is given in table 1. The results are averages of three determinations.

TABLE 1

Showing the Analysis of Milk before and after Irradiation

	BEFORE IRRADIATION	AFTER IRRADIATION
Specific Gravity at 25° C.	1.0271	1.0272
Specific Conductivity	0.0049	0.0046
pH	6.57	6.74
Total Solids	13.28	13.22
Ash	0.69	0.69
Fat	4.40	4.31
Total Protein ($N \times 6.38$)	3.48	3.42
Lactose	4.63	4.62
Sum (Ash, fat, protein, lactose)	13.20	13.04
Casein	2.50	2.47
Albumin	0.73	0.69

It will be seen that there are only slight differences in composition between the two samples. The pH of the irradiated sample is slightly higher than that of the non-irradiated sample. This can be accounted for on the basis of the reduction in bacterial count of the irradiated sample. Since the samples were not analyzed until the day following irradiation, more acidity may have developed in the untreated sample due to its higher bacterial count. Since ultraviolet light is known to cause a coagulation of albumin it was thought that possibly the albumin content of the irradiated sample would be considerably less than that of the untreated sample. The slight difference noted is hardly sufficient to be significant. Some of the difference can be accounted for by the lower total solid and protein content of the irradiated sample. Since the irradiated sample was irradiated eight times, it is certainly safe to say that normal irradiation by the process described does not cause detectable coagulation of the albumin in milk.

Chemical Composition of Butter Fat

In this work two samples of butter were used, one from untreated milk and the other from irradiated milk. The butter samples, of about a pound each, were melted and the butter fat used for the determination of various fat constants. Table 2 gives the results of the analyses. The results are averages of three determinations.

The most significant thing in table 2 is the shorter induction period for oxidation of the butter fat which had been irradiated. Irradiation undoubtedly initiates the oxidation process of the milk fat. It should be pointed out, however, that even after irradiation the sample studied had excellent

TABLE 2

Showing the Analysis of Butter Fat prepared from Milk before and after Irradiation

	BEFORE IRRADIATION	AFTER IRRADIATION
Refractive Index at 40° C.	1.4551	1.4551
Acid Number	0.93	0.96
Saponification Number	224.5	225.4
Acetyl Number	4.81	4.69
Reichert-Meissl Number	28.94	29.64
Polenske Number	1.51	1.89
Iodine Number	37.6	38.3
Kriest Test	Negative	Negative
Induction Period for Oxidation	20 hrs.	17 hrs.
Induction Period after 6 months storage	10 hrs.	8 hrs.

keeping qualities, superior to that of fat obtained from high quality creamery butter which gave an induction period for oxidation of 11 hours. In order to study the effect of irradiation on the keeping quality of butter fat the samples were stored in a refrigerator for six months and the induction period for oxidation determined again. It will be noticed that the induction period in both cases has been reduced about one-half. In other words the rate of deterioration is about the same in both cases.

In considering the fat constants it will be noticed that the changes after irradiation are slight. In every case except the iodine number the results lend themselves to the interpretation that slight oxidation has occurred. The higher acid, saponification, Reichert-Meissl and Polenske numbers of the irradiated sample, indicate a possible cleavage of long chain into short chain fatty acids. The lower acetyl number of the irradiated sample suggests the oxidation of hydroxyl groups. Since it is generally thought that oxidation takes place at the double bonds, one would expect a lower iodine number after irradiation. This is not the case. The higher iodine number after irradiation agrees well with the shorter induction period of this sample since unsaturated fats are known to have a shorter induction period than saturated fats. It is possible that irradiation shortens the induction period due to the introduction of double bonds in the molecule which is possibly a preliminary stage in the oxidation of a fat. Since such slight changes were found in fat exposed to such excessive doses of ultraviolet light, one can conclude that the usual dose would have an insignificant effect on the fat of milk.

Enzyme Studies with Pepsin

The object of this phase of the work was to determine what effect irradiation has on the rate of digestion of the proteins of milk by pepsin. The method used was as follows: 10 cc. of milk were placed in a beaker together

with 50 cc. of water and 5 cc. of 1.0 per cent commercial pepsin solution. This was then titrated with standard HCl solution to a pH of 2.0 at 25° C. using the quinhydrone electrode. This titration was made for both the irradiated milk and the control of non-irradiated milk. Next 10 cc. portions of each milk were placed in small Erlenmeyer flasks together with 50 cc. of water. The predetermined amount of standard HCl solution was then added to each flask to bring each solution to a pH of 2.0 after the addition of pepsin. These flasks were then placed in an incubator at 38° C. and allowed to remain there until they had reached a temperature of 38° C. Then 5 cc. of a 1.0 per cent commercial pepsin solution, which had a temperature of 38° C., were added to each flask. The flasks were kept at 38° C. throughout the experiment. At intervals two flasks of irradiated and of non-irradiated milk were removed and treated as follows: the samples were transferred to 200 cc. volumetric flasks and sufficient standard NaOH solution added to neutralize the added HCl solution and sufficient excess to make 14 cc. of N/10 NaOH in each flask. Then 4 cc. of Fehling's $CuSO_4$ solution were added to each flask and the solutions made up to volume. After a thorough mixing the solutions were filtered and 100 cc. portions of each filtrate were analyzed for nitrogen by the Kjeldahl method. The results indicate the amount of non-protein nitrogen present and are a measure of the amount of digestion taking place.

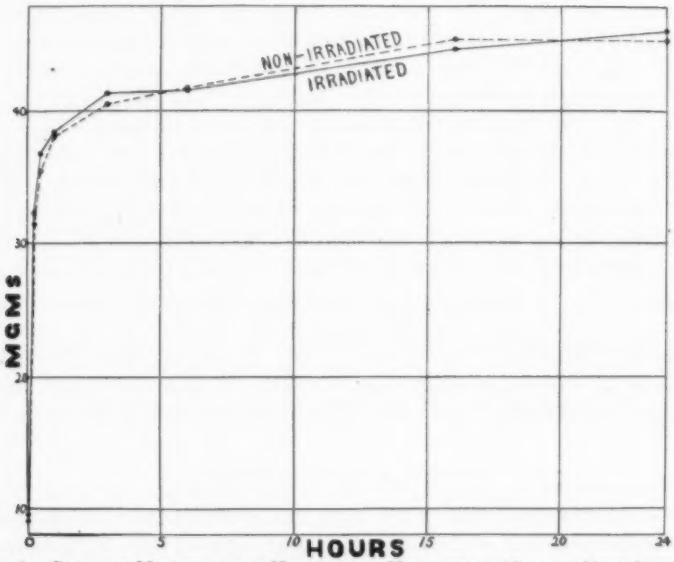

FIG. 1. SHOWING MILLIGRAMS OF NON-PROTEIN NITROGEN IN 10 CC. OF MILK DURING DIGESTION BY PEPSIN AT PH 2.0.

The above experiment was run several times and a typical set of results is given in Fig. 1. Each value is an average of duplicate determinations.

It should be noted that at the beginning of the experiment there was 0.5 mgm. more of non-protein nitrogen in the non-irradiated sample than in the irradiated sample. Hence, one should add 0.5 mgm. to each of the values in the curve for irradiated milk when comparing the two curves. If this were done the irradiated sample would show a greater amount of non-protein nitrogen at each period of analysis except the 16-hour period. Although the differences are not great, it appears that irradiation does not retard the digestion of milk proteins by pepsin but accelerates it slightly, especially during the early stages of digestion. Since the irradiated sample was given a heavy dose of ultraviolet light in this experiment as in the other experiments, it is very likely that normal irradiation by the process described has little effect on the digestibility of milk proteins by pepsin at a pH of 2.0.

Enzyme Studies with Trypsin

This phase of the work was very similar to that of the work with pepsin. The procedure differed in that the samples were brought to a pH of 8.1 with standard NaOH solution and at the end of digestion periods sufficient NaOH solution was added to make the total added equivalent to 14 cc. of N/10 NaOH. The trypsin used was a commercial preparation and 5 cc. of a 0.2 per cent solution were used in each flask.

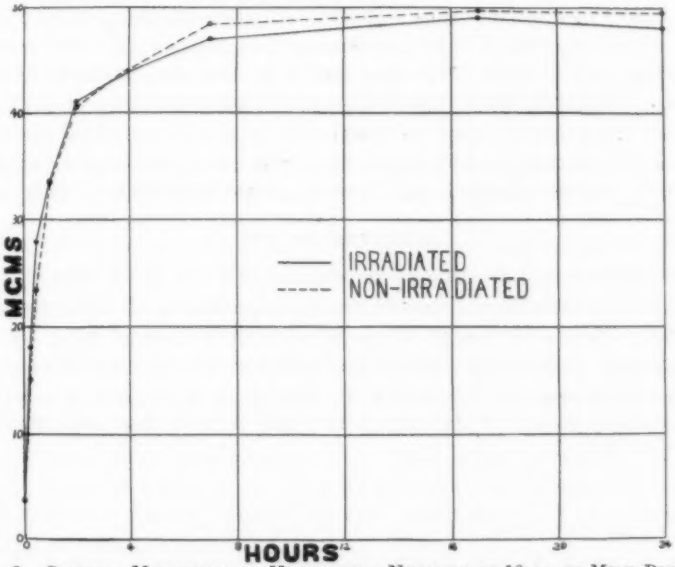

FIG. 2. SHOWING MILLIGRAMS OF NON-PROTEIN NITROGEN IN 10 CC. OF MILK DURING DIGESTION BY TRYPSIN AT PH 8.1.

Several experiments were run with trypsin, the results of a typical experiment being given in Fig. 2. The results are averages of duplicate determination.

The results of the work with trypsin are very similar to that with pepsin. The irradiated sample digests more rapidly during the early stages of digestion but finally after 4 hours the non-irradiated sample surpasses it. Here again it should be said that with normal irradiation by the method describes the differences would undoubtedly be very slight if detectable at all.

In explaining the more rapid digestion of the proteins of irradiated milk than of non-irradiated milk by pepsin and trypsin during the early stages of digestion, use may be made of the work of Wallen-Lawrence and Koch[2] who have demonstrated that boiled milk digests more rapidly than unboiled milk due to the destruction of anti-enzymes by boiling. It is possible that irradiation destroys or partially destroys the anti-enzymes in milk thus making irradiated milk more easily digested than milk not so treated.

SUMMARY AND CONCLUSION

A biochemical study has been made of milk and butter from milk treated with a heavy dose of ultraviolet light. Controls of non-irradiated milk and butter were also run. There is very little change in the composition of milk due to irradiation. Butter from irradiated milk has a shorter induction period for oxidation than that from non-irradiated milk. The variation in fat constants is slight. Digestion studies in vitro with pepsin and trypsin indicate a slight speeding up of digestion during the early stages of the process. This may be due to a destruction of anti-enzymes by ultraviolet irradiation. Normal irradiation by the method described would likely produce no detectable change in the composition or digestibility of milk.

ACKNOWLEDGMENTS

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VITAMIN A CONTENT OF PASTURE PLANTS

I. White Clover (*Trifolium repens*) and Kentucky Blue Grass (*Poa pratensis*) under pasturage conditions and fed green

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Vitamin A content of pasture plants deserves consideration, first because so large a proportion of the total feed supply of dairy cows is derived from pastures, and second because the vitamin A content of milk and butter may be influenced by the ration of the cow.

Sherman and Smith (11) suggest that the cow is able to store a surplus of vitamin A in the body during the summer months when fed green plants. This store may then be drawn upon during the winter months when the cow is fed dry feeds.

Under uniform stall feeding conditions McLeod, Brodie, and Macloon (7) found that milk varied little in vitamin A content from season to season. Drummond, Coward, and Watson (2) in 1921 pointed out that the vitamin A content of milk at different seasons is dependent upon the diet. Kennedy and Dutcher (5) found that the amount of vitamins A and B in milk depends upon the abundance of the supply in the feed of the cow.

That the vitamin A content of milk may be raised by the feeding of cod-liver oil, kale, or fresh pasture has been shown by Drummond, Coward, and Watson (2), Luce (6), Chick and Roscoe (1), and Golding, Soames, and Zilva (4). Golding (3) reported butter made from milk produced by cows fed green plants to be ten times as potent in vitamin A as butter made from milk produced by cows fed dry winter feeds.

The University of Idaho has 14 plots of grasses and legumes which are being studied in an effort to formulate desirable pasture mixtures. Data are being taken on growth habits, yield, palatability, and chemical composition. The influence of the cow's food on the vitamin A content of her milk suggested that the different grasses and legumes might vary sufficiently in vitamin A content to be an important consideration in formulating pasture mixtures.

This paper is a preliminary report on the biological analysis of the vitamin A content of white clover (*Trifolium repens*) and Kentucky blue grass (*Poa pratensis*), two of the most common plants used in pasture mixtures.

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EXPERIMENTAL PROCEDURE

The method used for determining the vitamin A content of these plants was based on the technique of Sherman and Munsell (10). Young rats, 28 to 29 days of age, were taken from mothers which had received Sherman's diet No. 13 ($\frac{2}{3}$ ground whole wheat and $\frac{1}{3}$ whole milk powder, plus 2 per cent of the weight of wheat in salt). These rats were placed on a basal vitamin A free diet. This basal diet consisted of 67 per cent corn starch, 18 per cent alcohol-extracted casein, 4 per cent salt mixture (Osborne and Mendel (9)), 10 per cent dried yeast, and 1 per cent salt. Fresh water and the basal vitamin A-free diet were always available.

Vitamins B and G were supplied by feeding dried yeast. One-pound cakes of a commercial yeast were placed in thin layers and allowed to dry at room temperature. When dry the yeast was ground and incorporated into the diet at a 10 per cent level. Vitamin D was furnished by 15 minutes' irradiation of the rats with a sun lamp at 30 inches.

Fresh, green samples of white clover and Kentucky blue grass were received once a week from the University of Idaho experimental plots. The plants were cut into fine bits by scissors. A sufficient number of doses for the week were weighed into one-fourth-ounce ointment jars with screw caps and placed in an electric refrigerator.

Each plant was fed at three levels, 60, 180, and 600 milligrams per week.

Three animals were kept in each cage for the first three weeks of the depletion period. At the end of the third week they were placed in individual cages made of one-fourth inch wire cloth. The bottom of each cage was raised to prevent access to feces.

At the close of the depletion period, determined by the cessation of growth and the appearance of ophthalmia, the rats were placed on experiment and continued for eight weeks.

Each animal was weighed once a week, and the food consumption recorded. Weighed doses of the plants were fed three times a week. Daily observations were made and notes taken on symptoms indicating a lack of vitamin A in the diet and a post-mortem examination was made of each animal.

RESULTS

Animals receiving 60 milligrams of clover per week (figure 1) made an average total gain in body weight of 48 grams during the experimental period of eight weeks. By the beginning of the third week the eyes of the five animals on this level of clover were again normal, and they remained so throughout the experiment. Post-mortem examinations showed that one of the animals had a small amount of pus in the nasal sinuses.

The five animals receiving 60 milligrams of blue grass made an average total gain in body weight of 25.8 grams in eight weeks, which is approxi-

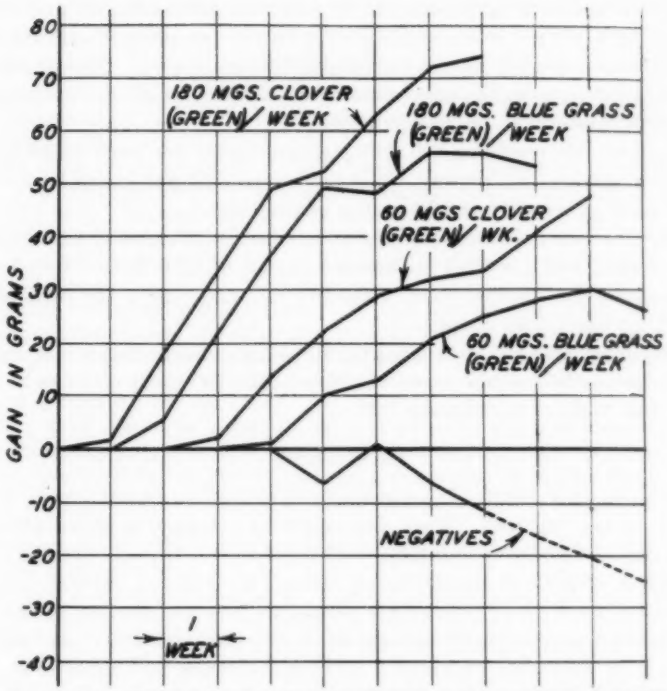

FIG. 1. AVERAGE WEEKLY GAIN OF RATS ON DIFFERENT FEEDING LEVELS OF WHITE CLOVER AND BLUE GRASS.

mately one unit gain.[1] None of the rats in this group recovered from ophthalmia during the experimental period. Post-mortem examinations showed that one of the animals had pus in the nasal sinuses, in the inner ear, and at the base of the tongue. A second animal had pus in the nasal sinuses and at the base of the tongue, while a third had pus in the nasal sinuses only. The remaining two were free from signs of infection.

At the level of 180 milligrams of clover, the rats made an average total gain of 74.6 grams. All signs of ophthalmia disappeared within a period of two weeks. While this gain is below normal, the animals were sleek and thrifty and approximately normal in appearance. Upon post-mortem examination one rat was found to have a small pus sac at the base of the tongue.

Animals receiving 180 milligrams of blue grass made an average total gain of 53.6 grams. While this group of animals lacked the sleek appear-

[1] The amount of a given food necessary to induce a gain of 3 grams per week for 8 weeks is considered to supply one rat unit of vitamin A.

ance of the animals on the same level of clover, their eyes were cured in the same length of time, and remained so, with the exception of one rat whose eyes showed a distinct narrowing during the eighth week. This animal was found to have pus in the nasal sinuses and at the base of the tongue, and a second rat had pus in the nasal sinuses only.

The two rats receiving 600 milligrams of clover per week made gains of 61 and 63 grams, respectively, while the two receiving the same level of blue grass made gains of 44 and 52 grams, respectively.

The five rats used as negative controls lost an average of 22.6 grams in body weight and survived an average period of 53.6 days. Post-mortem examination showed that four of the five rats had pus in the nasal sinuses and at the base of the tongue.

Computed on a rat unit basis these results indicate that under summer pasturage conditions blue grass contains about 100 units of vitamin A per gram and white clover contains 200.

DISCUSSION

Sherman and Smith (12) say that escarole is the richest source of vitamin A so far reported. They also report one sample of dried alfalfa as containing 100 units per gram. McLaughlin (8) studied the relation of vitamin A content to size of leaves, using New Zealand spinach. She reported a growth of 16 grams in 8 weeks on 70 milligrams per week of the very small leaves. On 90 milligrams of the same sample a growth of 41 grams in 8 weeks was obtained. In terms of vitamin A units these small leaves would contain from 90 to 150 units per gram.

Compared with results reported on other plant tissues, white clover (200 units) would be classed as one of the richest sources of vitamin A, while blue grass (100 units) would appear to be in about the same class as the young New Zealand spinach and the one sample of dried alfalfa.

Experiments are now in progress to determine the loss of vitamin A caused by drying these pasture plants, and it is also planned to continue the study of other pasture plants, both green and dried.

CONCLUSIONS

1. Results of a preliminary study of the vitamin A content of white clover (*Trifolium repens*) and Kentucky blue grass (*Poa pratensis*) have been presented.

2. The results of these experiments indicate that white clover contains at least 200 units of vitamin A per gram and blue grass is about one-half as rich.

3. Comparing these results with those of experiments reported on other plant tissues, white clover would be classed as one of the best sources of

vitamin A, while blue grass would be classed with the best sample of dried alfalfa.

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THE EFFECT OF PROLONGED HOLDING AT PASTEURIZATION TEMPERATURE ON THE PROPERTIES OF AN ICE CREAM MIX*

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INTRODUCTION AND REVIEW OF LITERATURE

This investigation was started as a result of a question raised by the Research Committee of the International Association of Ice Cream Manufacturers, as to what effect prolonged holding of an ice cream mix at pasteurization temperature would have on the properties of the mix and quality of the ice cream.

It is common practice in ice cream plants to pasteurize a batch of mix in a vat, and at the end of the usual holding period of 30 minutes, the mix is homogenized. The homogenization process may require thirty minutes to one hour or longer depending on the capacity of the machine. This means that some portions of the mix will be held for a longer period than other portions. It is also possible to encounter other delays, due to burned out fuses, cutting off of the power or a broken belt, in which case the mix might be held for abnormally long periods. Very little information is available on the effects of prolonged holding of the mix at pasteurization temperature. One phase of this work was studied by Martin, Swope and Knapp (1) who found that holding periods up to two hours, and pasteurization temperatures of 145, 155 and 165° F. had but little effect on the rate of overrun incorporation. The effect of various temperatures and holding periods on the bacteria content of ice cream has been studied by Fay and Olsen (2) and Fabian and Cromley (3) who demonstrated that 150° F. for thirty minutes was sufficient to destroy from 94.5 to 99.9 per cent. of the bacteria present in the mix. Although considerable work has been done on thermophilic bacteria in milk, conditions in an ice cream mix are somewhat different due to the presence of fat and sugar in a greater concentration. Yale (4) found that prolonged holding at pasteurization temperature in the case of milk did favor the development of thermophiles, but faulty plant operation proved to be more important in the development of these organisms than the type of pasteurizing equipment used.

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METHODS

A standard ice cream mix, made from unpasteurized sweet cream and skimmilk, sweetened condensed skimmilk, sugar and gelatine, calculated to contain 12, 10, 15 and 0.4 per cent fat, serum solids, sugar and gelatine, respectively, was used in this experiment. The ingredients were mixed together in a glass lined vat and heated to 150° F. and maintained at that temperature. A ten gallon portion of the mix was passed through a homogenizer at 2,500 pounds pressure at the end of 30 minutes, 1.5, 2.5 and 3.5 hours of holding. The first two gallons of mix over the cooler in each lot were discarded to make sure that the lot collected did not contain any mix from the previous batch which might have remained in the homogenizer and pipe lines, and also to make sure that the homogenizer was properly adjusted. The mixes were aged in ten gallon cans for 24 and 48 hours. Samples of the mix were taken in sterile bottles from the vat for bacteria counts, and other samples were taken from each lot of mix for the various determinations. Unpasteurized milk products were used in order to eliminate in so far as possible the effects of any previous heat upon the ingredients, the sweetened condensed skimmilk being the only previously heated milk product used.

Five trials were made, three of which were frozen in a 40 quart brine freezer, and two were made in a 40 quart direct expansion machine. Exactly 40 pounds of mix were used in each run. The brine temperature or suction pressure was kept constant through each trial so as to insure uniform freezing conditions. A preliminary batch was always frozen in order that the freezer would be thoroughly chilled before the experimental batches were frozen. Overrun determinations were made at minute intervals after the first two minutes and at half minute intervals near the end of the freezing process with a Mojonnier overrun tester. The temperature change throughout the freezing process was observed on a Centigrade thermometer graduated in one-tenth degrees. Samples of the ice cream were taken in one-half gallon tin cans, and hardened for quality determinations.

Five samples for bacteriological study were taken during each trial. The first or control sample was taken at the time the mixed ingredients had reached a temperature of 110° F. The remaining samples were taken at the same time the ten gallon portions were removed. The samples were packed in ice as they were taken from the vat and held until all the samples for a trial had been collected. They were then taken to the laboratory where duplicate dilutions of each sample were made as outlined in "Standard Methods of Milk Analysis." One set of the plates was poured with plain agar and incubated for 48 hours at 37° C. The other set was poured with dextrose agar and incubated at 62.5° C. to determine if the prolonged holding at pasteurization temperature might result in the growth of

thermophiles. Three trials failed to show any indication of growth of these organisms on the plates, so in the last trials the raw mix was inoculated with a culture of thermophiles to make sure of their presence in the mix.

Samples of the mixes taken for other laboratory studies were tested immediately after collection for viscosity, acidity, and protein stability; these same tests were also made on other samples which were held for 24 and 48 hours. The acid content of the mixes was determined by titrating a 9-gram sample with tenth normal sodium hydroxide, using phenolphthalein for an indicator. Viscosity tests were made with a MacMichael viscosimeter at 25° C., using a No. 27 wire on 3 cm. bob.

The protein stability was measured by a method devised for this purpose. An attempt was made to use the method described by Dahle (5) but it was not entirely satisfactory owing to the difficulty in observing the point of coagulation. Ten cc. of rennet extract and 240 cc. of distilled water were mixed together and 2 cc. of this solution added to 10 cc. of ice cream mix which had been diluted with 10 cc. of distilled water at 100° F. The time required for first signs of feathering was recorded as the coagulating time. The feathering was observed by frequently tilting the contents of the beaker used in this determination and as the mix flowed down the sides the first sign of feathering could be easily determined. This test gave consistent results and appears to have possibilities as a means of measuring the effect of heat on ice cream mixes.

EFFECT OF PROLONGED HOLDING OF A MIX AT PASTEURIZATION TEMPERATURE ON SOME OF ITS PROPERTIES

The titratable acid content of the mixes made in this experiment was very uniform, varying between 0.17 and 0.20 per cent. For the five trials the average acidity for each of the holding periods was found to range between 0.184 and 0.19 per cent with practically no variation between holding periods or between the fresh and twenty-four hour samples.

Samples of mix taken from the various lots immediately after homogenization and after aging twenty-four hours indicated that the prolonged holding had only slightly affected the viscosity. As the holding period was prolonged the average test of the five trials showed a gradual reduction from 26 to 15.2 centipoises on the fresh samples and 59.2 to 47.2 on the aged samples.

The time required for a weak rennet solution to produce the first signs of feathering of the mix was measured. This test indicated that the prolonged holding was changing the stability of the mix. The time required for feathering increased in direct proportion to the length of the holding period. Mixes held at 150° F. for thirty minutes would feather upon addition of the rennet solution in about two minutes, while mixes which had been subjected to heat for 3.5 hours would not show signs of coagulation

until 6 to 8 minutes had elapsed after the rennet was added. An attempt was made to determine the protein stability by means of measuring the number of cc. of 95 per cent alcohol and water required to produce coagulation; however, it was discarded in favor of the rennet test due to the inability of accurately judging just when coagulation took place.

TABLE 1

Effect of prolonged holding of a mix at pasteurization temperature on acidity, viscosity, and protein stability of fresh and 24 hours old mixes

(Average of 5 trials)

AGE OF MIX	HOURS HELD AT PASTEURIZATION TEMPERATURE							
	0.5		1.5		2.5		3.5	
	Fresh	24 hrs.	Fresh	24 hrs.	Fresh	24 hrs.	Fresh	24 hrs.
Acidity[1]	0.186	0.19	0.19	0.19	0.184	0.19	0.19	0.19
Viscosity[2]	26.00	59.2	23.8	68.4	21.8	53.6	15.2	47.2
Protein Stability[3]	2.26	3.0	3.12	4.0	4.15	4.8	7.0	6.6

[1] Titrable acidity.
[2] Viscosity in centipoises.
[3] Time in minutes required for first signs of coagulation.

EFFECT OF PROLONGED HOLDING OF A MIX AT PASTEURIZATION TEMPERATURE ON BACTERIA DESTRUCTION

The mixes used in this study were pasteurized in a glass enamel lined jacketed vat, using hot water for the heating medium. The temperature of 150° F. was selected, since it is quite generally used by ice cream plants and is regarded as satisfactory for bacterial destruction. Since this experiment involved the subjecting of the mix to pasteurization temperature for a rather extended period of time, it seemed that there might be a possibility

TABLE 2

Effect of prolonged holding a mix at 150° F. on the standard plate counts of five samples

TRIAL	CONTROL	HELD 30 MIN.	HELD 90 MIN.	HELD 150 MIN.	HELD 210 MIN.
1	9,400,000	4,800	1,900	1,900	2,000
2	8,200,000	6,400	3,500	2,600	3,100
3	5,200,000	3,300	3,200	4,200	3,800
4	6,900,000	10,000	10,000	11,000	9,900
5	22,000,000	30,000	41,000	19,000	3,800
Average	11,000,000	11,000	12,000	8,000	4,500

for the growth of thermophiles during the holding period. No thermophiles were present in the plates made from any of the mixes in the first three trials. In the last two trials the raw mix was inoculated with organisms which had been growing in milk at 150° F., but these organisms also failed to grow on the plates under the specified conditions.

The counts recorded in table 2 indicate that the greatest portion of bacterial destruction due to heating occurred during the first thirty minutes of holding. Extended holding at 150° F. over thirty minutes did not materially lower the standard plate count in any of the five trials.

EFFECT OF PROLONGED HOLDING OF A MIX AT PASTEURIZATION TEMPERATURE ON RATE OF OVERRUN INCORPORATION

Prolonged holding of the mixes at 150° F. apparently had no effect on the rate of overrun incorporation. Results obtained on twenty-one mixes held 24 and 48 hours, respectively, before freezing, showed that mixes held in the pasteurizer for 3.5 hours froze as rapidly as those held for shorter periods. In table 3 the time required to reach 100 per cent swell is recorded. This method of recording overrun might be subject to some criticism since it is difficult to determine at what interval the 100 per cent swell is obtained, as it is impossible to take samples less frequently than one every thirty seconds.

TABLE 3

Minutes required to obtain 100 per cent swell in mixes held for a prolonged period at pasteurization temperature

TRIAL NO.	HOURS HELD AT PASTEURIZATION TEMPERATURE			
	0.5	1.5	2.5	3.5
Mixes aged 24 hours				
1	11.0	10.0	9.5	9.5
2	13.5	13.5	13.0	13.5
3	9.0	9.5	9.5	9.0
4	12.0	11.0	11.0	11.0
5	10.0	10.5	12.0	11.0
Average	11.1	10.9	11.0	10.8
Mixes aged 48 hours				
1	9.0	8.0	10.0	10.0
2	11.5	12.0	12.0	11.5
3	8.5	8.0	8.5	8.5
4	10.5	9.5	11.0	12.0
5	11.0	10.5	10.0	10.0
Average	10.1	9.6	10.3	10.2
Average of 24 & 48 hours	10.6	10.25	10.65	10.50

Another way of expressing overrun is to record the amount obtained at the end of a certain period. In table 4 are recorded the overruns obtained at minute intervals after the first minute. It shows the rate of overrun incorporation as well as the amount obtained at the end of a 10 and 9 minute interval, respectively, for mixes aged 24 and 48 hours. When this method of expressing overrun was used, the results are slightly different from those expressed in table 3. The 48 hour mixes froze somewhat faster than the 24 hour mixes, however the prolonged heating did not seem to impair the rate of overrun except possibly to a slight extent in the 48 hour aged mixes, which on the average did not whip as fast in case of the 3.5 hours of holding when compared with 0.5 or 1.5 hours of holding.

TABLE 4

Effect of prolonged holding of mixes at pasteurization temperature on rate of overrun incorporation Data in per cent overrun

MINUTES	Hours held at 150° F.							
	AGED 24 HOURS				AGED 48 HOURS			
	0.5	1.5	2.5	3.5	.5	1.5	2.5	3.5
2	32.5	36.2	37.0	39.0	36.5	40.2	36.8	37.1
3	41.0	43.4	47.0	47.8	45.6	49.4	47.4	48.1
4	50.0	53.0	54.0	56.8	53.2	57.7	58.1	58.7
5	58.0	57.0	63.0	62.2	61.7	65.3	64.9	64.9
6	66.6	67.0	69.0	68.6	68.9	73.3	70.7	71.1
7	73.8	74.8	74.4	74.8	75.7	80.3	76.7	75.3
8	80.2	82.6	80.0	81.6	83.3	89.1	80.8	80.7
9	87.4	89.0	92.2	88.8	95.1	99.5	91.5	91.1
10	96.4	97.0	97.8	97.6				

EFFECT OF PROLONGED HOLDING ON THE QUALITY OF THE ICE CREAM

In only two instances did the judges detect any heated flavor in the finished ice cream, and then it was not serious. All the samples of ice cream were of excellent quality. The body and texture of the ice cream was equally good for the samples regardless of the length of the holding period as shown in table 5.

DISCUSSION AND SUMMARY

Five trials each consisting of four mixes were made in this experiment. Freezing was made of mixes held for 24 and 48 hours making forty individual freezings.

The results of this experiment indicate that ice cream mixes can be heated to 150° F. and held at that temperature for 3.5 hours without impairing the whipping properties or quality of the ice cream. Other

TABLE 5

Effect of prolonged holding at pasteurization temperature on the flavor and body and texture score of the ice cream made from mixes aged 24 hours

TRIAL NO.	HOURS HELD AT PASTEURIZATION TEMPERATURE							
	0.5		1.5		2.5		3.5	
	F	B	F	B	F	B	F	B
1	45.0	23.0	45.0	23.0	45.0	23.0	45	23.0
2	45.0	23.5	45.0	23.5	45.0	23.5	45	24.0
3	47.0	24.5	47.0	24.5	47.0	24.0	45*	24.0
4	45.0	24.0	45.0	24.0	46.0	24.0	45	24.0
5	46.0	24.0	46.0	24.0	46.0	24.0	45*	24.0
Average	45.6	23.8	45.6	23.8	45.6	23.7	45	23.8

F—Flavor score, perfect = 50.

B—Body and Texture score, perfect = 25.

* Slight heated flavor.

properties such as viscosity and protein stability are affected to some extent, the tendency being for a slight decrease in viscosity and an increase in the protein stability as the holding period is prolonged. From a bacteriological standpoint these trials would indicate that no serious trouble would be encountered from heat loving bacteria as determined by the plate count given in standard methods, provided the processing was properly done.

No attempt was made at a direct microscopic bacterial count; the results obtained were by the plate count method. The majority of the bacteria were destroyed at the end of a 30 minute holding period, the reduction being only slight after that time.

REFERENCES

(1) Martin, W. H., Swope, W. D., and Knapp, I. R. Problems in the manufacture of ice cream—Pasteurization temperatures. Penn. Agr. Expt. Animal Report 38, Bul. No. 196, 20–21. 1925.

(2) Fay, A. C., and Olson, N. E. The bacterial content of ice cream. Journal of Dairy Science 7: 330–336. 1924.

(3) Fabian, F. W., and Cromley, R. H. The influence of manufacturing operations on the bacterial count of ice cream. Mich. Agr. Exp. Station Tech. Bul. No. 60. 1923.

(4) Yale, N. W. The control of thermophilic bacteria in pasteurizing plants. Jour. Bact. 19: No. 1, 46–47. 1930.

(5) Dahle, C. D., and Barnhart, G. S. The effect of pasteurizing and homogenizing. Temperature on certain properties of ice cream mixes. Jour. Agr. Res. 42: No. 10, 678. 1931.

PROCEEDINGS OF THE 27TH ANNUAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

The 27th annual meeting of the American Dairy Science Association was held at the College of Agriculture, University of Kentucky, Lexington, on June 28th to 30th. The attendance was particularly pleasing to those in charge of the meeting for the registration showed approximately 200 men and 80 women. It is evident that there is an increased tendency for members to attend the meeting as a part of a vacation trip.

On the afternoon preceding the day of the opening of the meeting a conference on judging dairy products and a conference on judging dairy cattle were held in the dairy building. Special trips were taken by the ladies to see point of historic interest and to visit Berea College. On the second afternoon of the meetings both the men and women enjoyed a tour of the famous horse breeding establishments in the vicinity of Lexington.

For the second consecutive year the program committee prepared abstracts of all papers presented at the meeting which were purchased by attending members for use during the sessions and for later reference. Additional copies of these abstracts are still available and may be secured from Prof. Fordyce Ely, University of Kentucky, Lexington, at the regular price of $1.00 each.

The following program was presented.

GENERAL SESSION

Tuesday Morning, June 28, 1932—Memorial Hall

E. L. ANTHONY, President, American Dairy Science Association, presiding

Registration—Memorial Hall—University of Kentucky Campus.

Call to order, President E. L. Anthony.

Address of Welcome, Dean Thomas P. Cooper, College of Agriculture, University of Kentucky.

President's Address, E. L. Anthony, Michigan State College.

The Journal of Dairy Science, A. C. Dahlberg, Editor, New York Experiment Station, Geneva, New York.

Color of Milk as Affecting its Marketability, H. A. Ruehe and H. K. Wilson, University of Illinois.

Production, Merchandizing and Uses of Supreme Cream, Herman D. Wendt, West Chester, Pennsylvania.

Factors Influencing the Formation of Milk Layer in Bottled Coffee Cream, J. L. Mooney and L. H. Burgwald, Ohio State University.

Possibilities of Employing a More Simplified and Direct Method of Grading Creamery Butter, Roy C. Potts and C. E. Eckles, Bureau of Agricultural Economics, U. S. D. A.

A Method for Studying the Question of Stripping Following Machine Milking, W. E. Peterson and Phillip Swenson, University of Minnesota.

Soft Curd Milk, H. B. Monier and H. H. Sommer, University of Wisconsin.

The Effect of the Cow's Ration on the Vitamin (B and G) Content of Milk, W. E. Krauss, Ohio Agricultural Experiment Station.

DAIRY PRODUCTION PROGRAM

Wednesday Morning, June 29, 1932—Room 111 McVey Hall

G. BOHSTEDT, Section Chairman, presiding

The Vitamin A and D Requirements of Dairy Calves, I. W. Rupel, G. Bohstedt and E. B. Hart, University of Wisconsin.

A Study of the Anti-Rachitic Requirements of Calves,—The Anti-Rachitic Potency of Oat Straw, Dehydrated Hay and Semi-dried Hay, K. G. Landsburg and S. I. Bechdel, Pennsylvania State College.

Seasonal Composition of Pasture Grasses, R. H. Lush, Louisiana State University.

Dietary Acidosis in Dairy Cattle. A study of the results of feeding large amounts of high acid silage, acids, and single feeds and feeds in combination as measured by blood and urine composition, A. E. Perkins and C. F. Monroe, Ohio Agricultural Experiment Station.

Bone Meal and Marble Dust as Mineral Supplements to the Dairy Ration, W. H. Eaton, Alabama Polytechnic Institute.

Physiological Effects of Rations with Low Grade Roughage, E. B. Meigs and H. T. Converse, Bureau of Dairy Industry, U. S. D. A.

The Phosphorus Requirements of Milking Cows when Alfalfa Furnishes the Principle Source of Protein, C. F. Huffman, C. W. Duncan and L. W. Lamb, Michigan State College.

Calcium Deficiency in Growing Cattle, T. W. Gullickson and C. H. Eckles, University of Minnesota.

Comparison of the Blood Sugar Level of the Mammary and Jugular Veins of Dry and Lactating Cows, H. A. Herman and C. W. Turner, University of Missouri.

The Influence of Age of Cows and Age of Bulls on the Number of Services Required for Conception, R. F. Morgan and H. P. Davis, University of Nebraska.

Business Meeting.

WEDNESDAY AFTERNOON, JUNE 29, 1932

1:30 at Memorial Hall

Tour of Blue Grass Horse Farms and Estates.

C. V. Whitney Farm, Green Tree Farm, Elmendorf Farm, Dixiana Farm, Faraway Farm, Walnut Hall Farm, Coldstream Farm, Idle Hour Farm.

6: 30 Convention Banquet.

GENERAL SESSION

Thursday Morning, June 30, 1932—Memorial Hall

E. L. ANTHONY, President, American Dairy Science Association, presiding

The Effect of Leaving Milk in the Udder at Each Milking on Persistency of Yield, T. E. Woodward, Bureau of Dairy Industry, U. S. D. A.

The Digestibility of Fresh Whole Milk, Evaporated Milk and Powdered Whole Milk, D. D. Shaw and W. B. Nevens, University of Illinois.

The Digestibility of Milk *in vivo* as Affected by Certain Physical Treatments, C. Y. Cannon, D. L. Espe and F. N. Mortensen, Iowa State College.

Some Reactions of the Dairy Cow to Changes in Environmental Temperature and Humidity, W. M. Regan and G. A. Richardson, University of California.

Soybeans—Some of their Chemical and Physical Effects on Milk and Butterfat, J. H. Hilton, Purdue University.

Normal Growth of Dairy Cattle, J. B. Fitch, H. W. Cave and W. H. Riddell, Kansas State Agricultural College.

Laboratory Studies on the Chemistry of Soft Curd Milk, Samuel M. Weisberg, E. V. McCollum and Arnold H. Johnson, Research Laboratories, National Dairy Products Corporation.

A Comparison of the Milk Fat Values of Butterfat from Four Different Breeds of Dairy Cattle on Similar Feed, T. S. Sutton, Ohio State University.

Business Meeting.

DAIRY MANUFACTURES PROGRAM

Thursday Afternoon, June 30, 1932—Memorial Hall

R. B. STOLTZ, Section Chairman, presiding

Some Factors Influencing the Crystallization of Lactose in Ice Cream, Randall Whitaker, Research Laboratories, National Dairy Products Corporation.

The Use of Vegetable Stabilizers in Ice Cream, W. J. Caulfield and W. H. Martin, Kansas State Agricultural College.

New Developments as Regards the Behavior of Gelatin in Ice Cream, W. S. Mueller, Massachusetts State College.

Ash Content of Cocoa and its Influence on the Whipping Ability of Chocolate Ice Cream, Vincent Reeves and J. H. Erb, Ohio State University.

Prolonged Holding of an Ice Cream Mix at Pasteurization Temperature, W. H. Martin, Kansas State Agricultural College.

Limitations of the Dairy Science Score Card for Ice Cream, A. D. Burke, Alabama Polytechnic Institute.

Studies on Whipping Cream, Hugh L. Templeton, University of Wisconsin.

Factors Governing the Manufacture of Sweet Curd Cottage Cheese, L. M. Thurston, West Virginia University.

A Study of Cottage Cheese Made with Rennet, Martin F. Kelly and Walter V. Price, University of Wisconsin.

Some Developments in the Commercial Manufacture of (Philadelphia) Cream Cheese, E. L. Reichart, University of Nebraska.

Relation between Titrable Acidity, Hydrogen Ion Concentration and Quality of Cheddar Cheese during the Making and Ripening Process, L. W. Brown and Walter V. Price, University of Wisconsin.

DAIRY PRODUCTION PROGRAM

Thursday Afternoon, June 30, 1932—Room 111 McVey Hall

G. BOHSTEDT, Section Chairman, presiding

Cottonseed Meal in the Ration of Calves Under Six Months of Age, J. P. LaMaster, Clemson Agricultural College.

The Nutritional Value of Cottonseed Meal as Affected by the Absence of Various Dietary Factors, S. I. Bechdel and R. S. Williams, Pennsylvania State College.

Some Physiological Effects of Gossypol, L. A. Moore, Michigan State College.

Wheat in the Dairy Ration. Its Effect on the Cow, Production and Product. Two Experiments, C. F. Monroe and C. C. Hayden, Ohio Agricultural Experiment Station.

The Value of Oat Feed when Fed in Grain Mixtures and as a Hay Substitute for Dairy Cattle, G. Bohstedt, A. W. Lathrop and A. H. Walker, University of Wisconsin.

Types and Varieties of Corn for Silage in the Corn Belt. Preventing Surface Losses in Silo, W. B. Nevens, University of Illinois.

Soybeans for Silage, R. B. Becker and W. M. Neal, Florida Agricultural Experiment Station.

Methods for Testing Palatability of Roughages and some Preliminary Results, C. H. Eckles, University of Minnesota.

The Feeding Value and Effect of Mint Hays, George E. Taylor, Michigan State College.

A Score Card for Production Records of Dairy Cows, C. E. Wylie, University of Tennessee.

Lactation Revords vs. 12 Months Records for Proving Dairy Bulls, J. C. McDowell, Bureau of Dairy Industry, U. S. D. A.

More Evidence on Proved Sires, R. R. Graves, Bureau of Dairy Industry, U. S. D. A.

MINUTES OF THE EXECUTIVE COMMITTEE MEETING ON THE EVENING OF JUNE 27, 1932, LEXINGTON, KY.

E. L. ANTHONY, *President, presiding*

Those in attendance at meeting:—

R. B. STOLTZ, Vice President.
A. C. DAHLBERG, Editor.
G. BOHSTEDT, Chairman of Production Section.
T. W. GULLICKSON, Sec. of Production Section.
M. J. REGAN, Chairman of Extension Section.
ROY C. POTTS, Secretary of Dairy Economics Section.
R. B. BECKER, Chairman of Southern Section.
E. S. GUTHRIE, Chairman of Eastern Section.
R. R. GRAVES, Sec.-Treasurer.

Becker, of Florida, presented the following resolution to the Executive Committee:

"I move that the author, or one of the authors, of each paper presented on the program of the American Dairy Science Association meeting, with the exception of invited speakers, be a member of the association in good standing."

This motion was adopted and it was the consensus of the Executive Committee that this also apply to the meetings of the Divisions of the American Dairy Science Association.

A motion was also adopted to the effect that the Committee on Standardization be permitted to utilize the funds accrued from the sale of separates to publish new standards.

The following committee to work with the Bureau of Standards on the standardization of dairy containers was approved:

PROF. M. MORTENSEN, of Iowa.
PROF. R. B. STOLTZ, of Ohio.
WM. WHITE, Bureau of Dairy Industry.

Professor Stoltz moved that the association invest its present savings account and any additional funds, that in the judgment of the Secretary-Treasurer are not needed for current expenses, in government securities.—Adopted.

The appointment of an Auditing Committee, consisting of J. C. McDowell and R. W. Bell, of the Bureau of Dairy Industry, was approved.

Regan, of Missouri, made a motion that a financial statement be sent each member of the Executive Committee, when the report is audited at the end of the year. Motion carried.

A Nominating Committee, consisting of C. H. Eckles, Chairman, H. O. Henderson, O. E. Reed, Fordyce Ely and Roy Harris, was approved.

A Resolution Committee, consisting of H. B. Davis, Chairman, Earl Weaver, C. E. Wylie, H. W. Gregory, and Ted Besh, was approved.

The report of the Editor was approved and the report of the Secretary-Treasurer was also approved.

The reappointment of Dr. Otto Hunziker to the Journal Management Committee for a period of three years was approved.

C. H. Eckles, Chairman of the Committee on Constitution, discussed with the Executive Committee, the changes in constitution that will be required to meet the requirements of the laws of the District of Columbia under which the association is incorporated.

Professor Guthrie moved that the Committee on Constitution consider a method for the nomination of officers in such manner that the Vice President automatically becomes the President of the association. This motion was carried.

Invitations were received for the 1933 meeting from the following:

University of Minnesota.
Cornell University.
Pennsylvania State College.
Purdue University.
University of Illinois.
Ohio University.

There was some sentiment in favor of the 1933 meeting being held as close to Chicago as possible in order that the members might attend the Century of Progress Exposition, either before or after the American Dairy Science Association meeting.

The choice of the Executive Committee in regard to the place of the 1933 meeting will be announced in the near future.

There was some informal discussion relative to memorials in the JOURNAL for deceased members of the association.

A. C. Dahlberg was appointed Editor and R. R. Graves was appointed Secretary-Treasurer.

MINUTES OF THE BUSINESS MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION, AT LEXINGTON, KENTUCKY, JUNE 30, 1932

Report of Production Section approved.
Report of Manufacturing Section approved.
Report of Extension Section approved.
Executive Committee Report approved.

A motion had been adopted in the Manufacturing Section to the effect that a committee be appointed by the Executive Committee to consider publication of abstracts in the JOURNAL. This motion was defeated by the

Dairy Science Association meeting as a whole. It was then moved by Stoltz, of Ohio, that the above recommendation of the Manufacturing Section be referred to the Committee on Journal Management. This motion was carried.

Professor A. A. Borland moved a vote of thanks to Professor Ely and his co-workers for the preparation of the abstracts of papers of the 1932 meeting. Carried.

Professor Ragsdale, of Missouri, reported on changes in plan for dairy improvement contests. The Executive Committee had previously decided that this committee on Dairy Improvement Contests would be carried forward but that its future would depend upon the renewal of the National Dairy Show.

C. H. Eckles, Chairman of the Committee on Elections, submitted the following nominations:

For President and member of Board of Directors for one year:
E. L. ANTHONY, Michigan.
H. C. JACKSON, Wisconsin.
For Vice-President and member of Board of Directors for one year:
R. B. STOLTZ, Ohio.
EARL WEAVER, Oklahoma.
For members of Board of Directors for one year term:
C. L. ROADHOUSE, California.
C. R. GEARHART, Pennsylvania.
For two year term:
H. B. ELLENBERGER, Vermont.
O. HUNZIKER, Illinois.
For three year term:
L. A. ROGERS, District of Columbia.
H. A. RUEHE, Illinois.

Professor C. E. Wylie, in the absence of Professor Davis, presented the report of the Resolutions Committee, which follows:

1. Resolved that the American Dairy Science Association express their appreciation to Professor Fordyce Ely, members of his staff, the officers of the University of Kentucky, Lexington Board of Commerce, the Kentucky Dairy Products Association, as well as other individuals and concerns who have cooperated in furnishing the splendid provisions for the comfort and entertainment of the twenty-seventh annual meeting of the American Dairy Science Association.

2. Resolved that the Association express to the Program Committee consisting of Fordyce Ely, C. L. Roadhouse and Martin Mortensen, their appreciation of the preparation of the program and the printed abstracts which have been so helpful to their members, also to H. B. Morrison and Miss Nellie Lawrence who edited the abstracts.

3. Resolved that the Association commend A. C. Dahlberg, editor, and the Journal Management Committee of the JOURNAL OF DAIRY SCIENCE, for the splendid work in improving and enlarging the activities of the JOURNAL OF DAIRY SCIENCE.

4. Resolved that the Association express to President and Mrs. McVey their gratitude for the delightful garden party given for the members and their wives.

5. Resolved that the Association express to Mrs. Ely and her co-workers its appreciation for the numerous and delightful entertainments provided for the ladies.

6. Whereas, the Dairy, Ice Cream and Machinery Supply Association have shown a real interest in our dairy products students' judging contest held annually at the National Dairy Industry Exposition and have furnished financial aid for conducting the contest and funds for fellowship for winners in the contest, be it resolved that the Association express their appreciation for this splendid interest and support.

O. E. Reed was reappointed as representative of the American Dairy Science Association to the National Research Council.

Roy C. Potts, of the Bureau of Agricultural Economics, U. S. D. A., spoke in favor of development of an economics program as a part of the annual program.

Professor Ruehe, of Illinois, spoke in favor of the developments of the college teaching section as a part of the program for the National Meeting.

O. E. Reed, of the Bureau of Dairy Industry, U. S. D. A., reported on activities as representative of the association to the National Research Council meetings.

Professor Fitch, of Kansas, and Professor Wylie, of Tennessee, spoke in favor of honoring members at the National meeting, who have rendered distinctive service to the dairy industry.

Professor Mortensen, of Iowa, moved that a committee be appointed to investigate the basis on which certificates should be granted by colleges for non-collegiate work in dairying. This motion was carried.

ACTIVE MEMBERSHIP OF AMERICAN DAIRY SCIENCE ASSOCIATION

September 1, 1932

ACKERMAN, RICHARD A., Reymann Memorial Farms, Wardensville, W. Va.
ADDINGTON, LAWRENCE H., N. Mex. A. & M. College, State College, N. Mex.
ALEXANDER, C. B., The Akron Pure Milk Co., 273 Bowery St., Akron, Ohio.
ALEXANDER, WADE F., Bur. Milk Sanitation, State Dept. Health, Albany, N. Y.
ALGER, HARRY B., 12133 Northlawn Ave., Detroit, Michigan.
ALLEN, NAT. N., University Farm, St. Paul, Minn.
ALTWEGG, C. ALBERT, American Milk Products Corp., 48 rue Ampere, Paris 17 e, France.
ANDERSON, ALBIN E., University Farm, St. Paul, Minn.
ANDERSON, E. E., State College, New Mexico.
ANDERSON, E. O., Conn. Agr. College, Storrs, Conn.
ANDERSON, J. ARLINGTON, Rutgers University, New Brunswick, N. J.
ANDERSON, S. H., Exec. Secy. National Dairy Assoc., 511 Locust St., St. Louis, Mo.
ANSBACHER, S., The Dry Milk Co., Inc., Bainbridge, N. Y.
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ARMSTRONG, TALBOTT V., 801 Cherry Ave., N.E., Canton, Ohio.
ASTROTH, FRANK B., 1453 Hythe St., St. Paul, Minn.
ATKESON, F. W., College of Agr., Moscow, Idaho.
AYRES, HARVEY L., University of Maryland, College Park, Md.
AYRES, W. E., Cornell Univ., Ithaca, N. Y.
ATKINSON, L. A., Fraser Valley Milk Prod. Assn., 405 8th Ave. W., Vancouver, B. C.

BAINES, JOHN C., Twin City Milk Prod. Assn., 1001 Glenwood Ave., Minneapolis, Minn.
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BAKER, N. R., 239 W. Spring St., Columbus, Ohio.
BALDERSTON, ROBERT W., National Dairy Council, 221 North La Salle St., Chicago, Illinois.
BALDWIN, FRANK BRUCE, University Farm, St. Paul, Minn.
BASS, LAWRENCE W., The Borden Co., 350 Madison Ave., New York, N. Y.
BAYER, A. H., 710 Eastern Ave., Schenectady, N. Y.
BEAM, A. LELAND, State College, Pa.
BECHDEL, S. I., State College, Pa.
BECKER, R. B., Univ. of Florida, Gainevsille, Fla.
BELL, R. W., 4409 Greenwich Parkway, Washington, D. C.
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BENDIXEN, H. A., State College of Wash., Pullman, Wash.
BENNETT, FREDERICK W., State College of Agric., Athens, Ga.
BERGFORD, H. L., 221 Fifth St., South, Moorhead, Minn.
BERRY, M. H., Univ. of Maryland, College Park, Maryland.
BESSEMER, A. M., Golden State Co. Ltd., 425 Battery St., San Francisco, California.
BIGELOW, A. P., 330 Woodland St., Hartford, Conn.
BLACKMAN, CHAS. L., Ohio State Univ., Columbus, Ohio.
BOHSTEDT, GUS, College of Agric., Agricultural Hall, Madison, Wis.
BOISVERT, OSCAS, Escole de Laiterie, St. Hyacinthe, P. Q., Canada.
BORLAND, A. A., State College, Pa.
BOUDEWYNS, CELESTIN, Health Officer, Westwood, N. J.

Bouska, Frank J., Iowa State College, Ames, Iowa.
Bouska, F. W., Beatrice Creamery Co., 1526 South State St., Chicago, Ill.
Bowling, G. A., West Virginia Univ., Morgantown, W. Va.
Brandt, P. M., Oregon Agr. College, Corvallis, Oregon.
Brannon, J. M., Univ. of Illinois, Urbana, Illinois.
Breed, Robert S., Agr. Exp. Station, Geneva, N. Y.
Brew, James D., Bur. of Milk Sanitation, State Dept. of Health, Albany, N. Y.
Briggs, Walter M., Pleasanton, Alameda Co., California.
Britt, James A., City Consumers Co., Paducah, Ky.
Brody, Samuel, Univ. of Missouri, Columbia, Mo.
Brown, Royer H., The Jersey Bulletin, 602 Majestic Bldg., 47 S. Pa. St., Indianapolis, Ind.
Brueckner, Herman J., Cornell Univ., Ithaca, N. Y.
Bulmer, Leonard C., Director, Bureau of Food and Dairy Inspt., Dept. of Health, Birmingham, Ala.
Burgwald, L. H., Ohio State Univ., Columbus, Ohio.
Burke, A. D., Box 205, Alabama Polytechnic Inst., Auburn, Ala.
Bush, James A., Room 17, Johnson Bldg., Amarillo, Texas.
Button, F. C., N. J. Agr. Exp. Station, New Brunswick, N. J.
Buttrick, David H., 30 Mill St., Arlington, Mass.

Caine, Geo. B., Utah Agr. College, Logan, Utah.
Camburn, O. M., Vt. Agr. Exp. Station, 489 Main St., Burlington, Vt.
Campbell, M. H., Univ. of Vermont, Burlington, Vt.
Campbell, P. A., Eastern States Farmers Exchange, Springfield, Mass.
Canan, R. D., 823 Lafayette Life Bldg., Lafayette, Ind.
Cannon, C. Y., Iowa State College, Ames, Iowa.
Carver, R. J., Moore-Ross Milk Co., Columbus, Ohio.
Caufield, W. J., College of Agr., Manhattan, Kans.
Cave, H. W., College of Agr., Manhattan, Kan.
Chryst, Eugene, East Center St., Germantown, Ohio.
Clevenger, W. L., State College, Raleigh, N. C.
Cole, Wilford C., College of Agr., Davis, California.
Colman, H. N., Ore. Agr. College, Corvallis, Ore.
Combs, W. B., Univ. Farm, St. Paul, Minn.
Conklin, C. T., Ayrshire Breeders Association, Brandon, Vt.
Cook, A. S., Walker-Gordon Laboratory Co., Plainsboro, N. J.
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Cordes, William A., Blue Valley Cry. Co., 1137 S. Jackson Blvd., Chicago, Illinois.
Coulter, S. T., Univ. Farm, St. Paul, Minn.
Craig, R. S., % Bur. of Chemistry and Foods, Baltimore, Md.
Crosby, J. E., Jr., Univ. of Missouri, Columbia, Mo.
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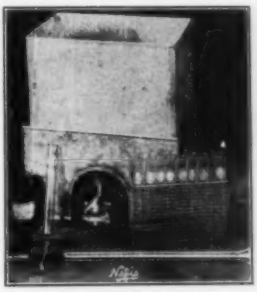

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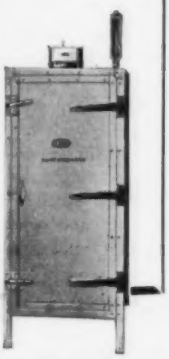

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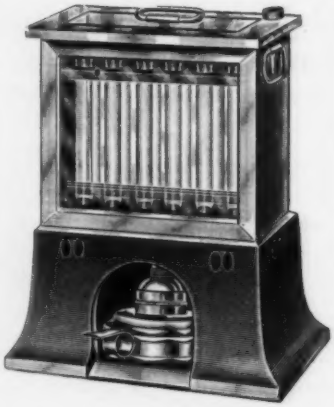

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